AUTOMATA MAGAZINE

Clowning around with automata

Volume 3, Number 3 • May – June 2021

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EDITORIAL

Tim Hunkin

by Marc Horovitz

I first discovered Tim Hunkin over 30 years ago through his television series, *The Secret Life of Machines*. For those not familiar with these shows (all of which are available on YouTube and Tim Hunkin's website), they explore the workings of everyday household machinery—washing machines, vacuum cleaners, sewing machines, and many more. The machines are dismantled and clearly explained by Tim with humor and tremendous understanding. His style is down to earth and the most complex concepts are presented in such a way as to be understandable by virtually anyone. No engineering degree is required.

Tim Hunkin has had an amazing and diverse career. He's been an engineer, sculptor, clockmaker, automatist, cartoonist, inventor, author, teacher, and more. By his own admission, he thrives on diversity. His book of mechanically oriented cartoons, *The Rudiments of Wisdom*, is still available on the second-hand market.

To showcase some of his seemingly endless creations, Hunkin opened two arcades that hark back to the early part of the last century. One of them, Under the Pier, is in Southwold, England, while the other, Novelty Automation, is in London (see Holly Bollinger's article in the September-October 2019 issue of *Automata Magazine*). These two popular attractions are filled with coin-operated games, automata, and other machines, all designed and built by Hunkin, and all reflecting his ingenuity and humor.

I was strongly influenced by Tim Hunkin in my own early days. I watched *The Secret Life of Machines* many times and saw his automata outside Cabaret Mechanical Theatre when it was still in Covent Garden. I enjoyed Tim's casual, easy-going approach to complex problems. What was particularly impressive to me was the way he was able to simplify things and break them down into easily understood components, then show how all of the components worked together to form the whole.

Therefore, I was delighted to learn that Tim Hunkin has released a new series of eight videos, called *The Secret Life of Components*, that should be of great interest to automatists. By the time you read this, all eight programs will have been posted on his website. Topics include Chains and Belts, Switches, LEDs, Springs, Connectors, Glue, Hinges, and Bearings.

I have viewed them all and found them well up to the Hunkin standard. Like *The Secret Life of Machines*, this series is well produced (albeit on a low budget), and is packed with good information for the mechanically minded. All concepts are lucidly and entertainingly explained by a man who clearly knows his business. The videos are not slick but they have an endearing, down-home quality that cannot fail to please.

If you're already familiar with Tim Hunkin's work, you'll be gratified by these new offerings. For those unfamiliar with him, you're in for a treat. Check it out, along with the rest of his amazing website: https://www.timhunkin.com/

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Thanks to all of you who responded to our survey. We've published the results in this issue on page 5, so please have a look.

NEWS

Drawmaton has recreated Leonardo da Vinci's *Robot Knight* (or at least part of him) in celebration of the 500th anniversary of Leonardo da Vinci's death.

The *Robot Knight* was an early proto-computer android whose read-only programmable memory allowed it to perform many actions. It was also rumored that the robot could even perform an extremely complex task—draw a picture.

World-famous mechanical engineering wizard Robert Sabuda has unlocked the secrets of da Vinci's robotic arm. The final result is da Vinci's Drawmaton.

Supplied in kit form and made only of wood and a few pieces of metal, Drawmaton is capable of reading 1KB of analog memory via wooden "petalos" which, to da Vinci the naturalist, resembled the petals of flowers.

Petalos are easily interchangeable, so the Drawmaton can draw an endless variety of single-line images. A full rotation of the petalo sends the information down to the robot's arm and hand. Any drawing tool can be placed into the robot's hand. Paper is then placed into the drawing area and, with a turn of the knob, a drawing is revealed. More information: www.drawmaton.com

Shasa Bolton has a new pet-shop-themed series of kits, based on a planetary gear mechanism. There is a bird that banks coins, a tortoise that can count, and a fortune-telling fish. Price: $64 AUD ea; outside Australia, $84 AUD ea., incl postage. Complete information: https://www.contraption-cart.com/blog/gearbox-pets

Timberkits Ltd. is offering a new Traction Engine automaton, their most elaborate and ambitious design to date. With 306 components, this is a project for the serious model maker. The model includes many ingenious mechanisms and pays homage to the great era of steam driven engineering. Price, £79.00/$110.50 plus carriage.

Email: timberkits@btconnect.com
Website www.timberkits.com

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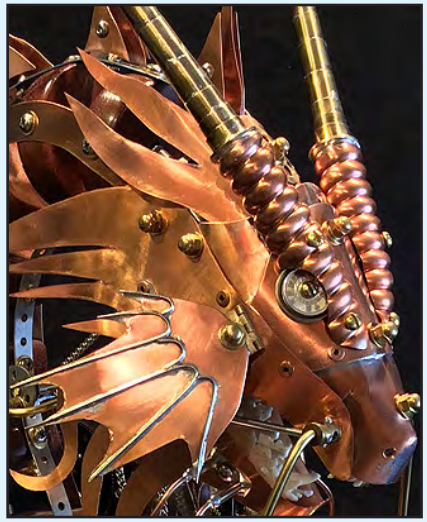
In the next issue of

AUTOMATA MAGAZINE



- *Tatsu the Water Dragon*, a new automaton by David Bowman
- Traditional ramp walkers, defined and depicted by Barry Falkner
- Building automata in the virtual world, by ZaBen Yan
- Dan Strout discusses his process in automata design and construction

EVENTS

AutomataCon,
May 20-22, 2022.
Morris Museum, Morristown, New Jersey, USA. For more information, visit https://www.automatacon.org/

Morris Museum: Natural Essence: Motion Perceived
March 18-August 15, 2021
Contemplate the hidden beauty and majesty of movement within the essence of nature, featuring the works of five artists. Explore and appreciate this enchanting collection of kinetic and illusory works that speak to the imagination of the spirit and richness of the natural world.

CALL FOR ENTRIES

Morris Museum: A Cache of Kinetic Art: Timeless Movements
Friday, March 18-Sunday, August 7, 2022.
A Cache of Kinetic Art is a multi-year juried exhibition series showcasing contemporary automata and their inventive creators. Submission deadline: Friday, Sept. 10, 2021. Prospectus and entry forms for both exhibitions: https://tinyurl.com/MMentries

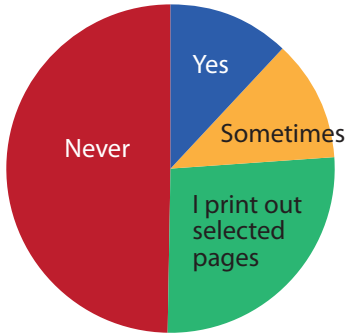
Printed copies of *Automata Magazine*

We have available a limited number of printed copies of several issues of *Automata Magazine*. Due to high postage costs, we can only offer these to those with US addresses.
The cost of each issue is $15 + $4.75 postage. For further details and a list of available issues, please write to automatamag@comcast.net

SURVEY RESULTS

Thanks to all of you who completed *Automata Magazine's* online survey and left comments. All suggestions will be seriously considered. Here is a summary of the results.

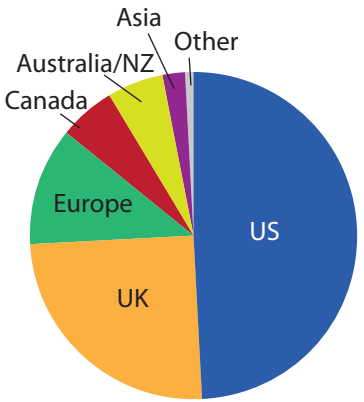
Those who print out Automata Magazine



72%
are happy with the current US letter size

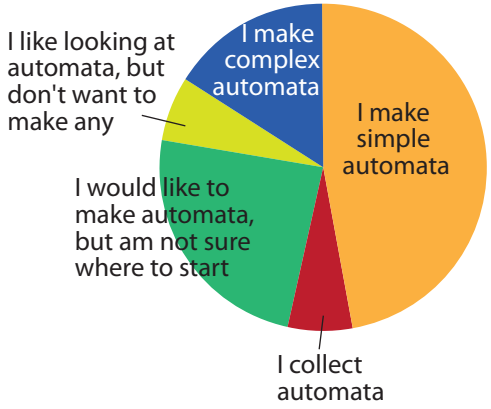
70%
of readers who view the magazine on a device do so on a computer

Area of the world in which respondents live



89%
love the magazine as it is

Description respondents give themselves



Reader suggestions include wanting more detail on mechanisms, instructions/plans for making the components of simple automata.

An artist's process

A discussion of automata, design, and production

by Tim Douglas • Northampton, England • Photos by the author

I've had no training in woodworking, design, engineering, or anything connected to automata. Fortunately, I have a gift of being able to see things work just by thinking.

My interest in automata began when I visited Cabaret Mechanical Theatre in Covent Garden, London, many years ago. I thought, "I could make one," and I did so. It was simple, badly made, and the mechanism was unreliable, but I learned a great deal from that experience.

As I made more, I began to make my pieces more and more complex, capturing a moment in time with which to amuse the viewer. My wife kept telling me, "Make it simple," but I never did. For me, the challenge is in the subject and making that subject work smoothly and come alive. I also like to use a multitude of exotic woods, which show off the beauty and diversity of available materials and add dimension to the piece.

1. *Saucy Seaside.*

2. Mechanism for *Saucy Seaside*.

I have now been making wooden automata for around 16 years and I have 26 pieces on YouTube. Most of my pieces have fairly complex sequential mechanisms that, I hope, enhances the viewer experience.

Automata

To give you an idea of my work, below are some of my automata.

Saucy Seaside (**photos 1** and **2**), 35cm wide x 30cm high x 25cm deep (13¾" x 11¾" x 9¾", respectively). A worm drive turns the main gear and shaft. An additional crank and levers activate the two children and there is a drop cam for the fat lady. I tried to include some aspects of old postcards into the design.

Time for a walk (**photo 3**), 2016; 38cm wide x 30cm high x 21cm deep (15" x 11¾" x 8¼", respectively). A worm drive again powers the main shaft. There is also a double drive that uses identical gears for rotation. Movements are all controlled by cams and levers. The newspaper

3. *Time for a Walk*.

4. *Dracula* (risen).

5. *Dracula* (below).

was copied from old pictures and printed on lightweight paper. The floor was made from pre-cut oak pieces and laid in a herringbone pattern.

Dracula (**photos 4** and **5**), 2018, 34cm wide x 40cm high x 24 deep (13⅜" x 15¾" x 9⅜", respectively). This piece was challenging. The mechanism for lifting the platform and coffin needed to be smooth and fairly quick. I failed several times, until I used AutoCAD to help in the design. The original coffin was made of ebony but was too heavy. I made a copy in balsa wood and painted it black. The other problem was that Dracula had to sit up and turn his head. This meant that the coffin lid could not be attached to the mechanism. Eventually, I worked it out. A mercury switch turns on the current to the LED light in the sun.

Farting Man (**photo 6**), 2019; 34cm wide x 27cm high x 30cm deep (13⅜" x 10⅝" x 11¾", respectively). A worm drive powers a gear on the drive shaft. Seven cams operate the piece. I changed most of the mechanism as I went along. The parrot was difficult, as its wings would not fold down properly when it returned to its upright position.

Pancake Day (**photo 7**), 2011; dimensions unknown (sold). This piece has four gears that reduce the crank speed to 9:1. The frying-pan lift uses a double lever, while the pancake flip uses cotton thread and weights to turn the pancake. The head-turn mechanism has a rack-and-pinion to allow for a full turn.

Marilyn Monroe (**photo 8**), 2015; 34cm wide x 41cm high x 21cm deep (13⅜" x 16⅛" x 8¼", respectively). This piece was based on the scene from the film *Some Like it Hot*. The piece contains two electric fans that are controlled by a cam. Unfortunately, I needed to install a support behind her for the cotton thread that controls her body movement. A local seamstress made the dress for my model. I originally tried magnets to lift the dog's ears, but this didn't work. Instead, I used fishing line through its head and attached the ears to the line to provide the lift.

6. *Farting Man*.

7. *Pancake Day*.

Automata design

I often get requests from people who ask if I could provide plans for the automata that I build. My answer is always "no." The reason for this is not because I mean to be unhelpful or secretive; it is because I do not even draw any plans for myself. Most of them are in my head.

When I have an idea for a piece, I normally sketch designs for the different mechanisms in a drawing book. Even though I have made so many different automata, I always need new mechanisms for each piece.

Designing the mechanics is always the most interesting and challenging part of the build. I have an idea that I think will work, but until I actually make it I am never sure. For example, in my latest piece, *Farting Man*, I included a parrot. The parrot is supposed to fall backwards unconscious, which would make its wings droop down. I assumed that when the bird was set upright again, gravity would act on the wings and return them to their proper position. I was wrong—they stayed up. I needed to adapt the mechanism to compensate for this. I tried using copper for the wings, but in the end I used a different hinge system.

Sometimes I find it difficult to think of the mechanics to achieve a certain action. However, I learned over the course of time that there is always an answer. Discovering it just requires perseverance and keeping it as simple as possible.

The more pivot points and mechanisms there are in a piece, the less efficient the action becomes. The design must be smooth in operation, have the correct speed and be able to operate with the provided drive.

I normally use a worm drive connected to the crank handle. This interacts with the main gear, which is mounted on a shaft that provides the drive to the cams.

During the design process, I calculate the timings. My wife aids me by using a stopwatch while I go through the actions. This will dictate the number of teeth on the main gear. For instance, if I plan a 25-second complete operation, I then design a 25-tooth gear, as I estimate that the crank should be turned on a one-second cycle.

My automata often have six or more operations and I normally use cams and levers to control the movement. Cams can be designed to start and end the action when I want, with the speed of the action controlled by making steep or shallow curves on the cams. The levers, or cam followers, then control the mechanism. I have to calculate the timing to ensure that all the operations are completed within the single rotation of the main gear.

I also like to include sound effects and lights. For these I use cheap audio circuit boards, microphones, speakers, and low-voltage (9V) bulbs.

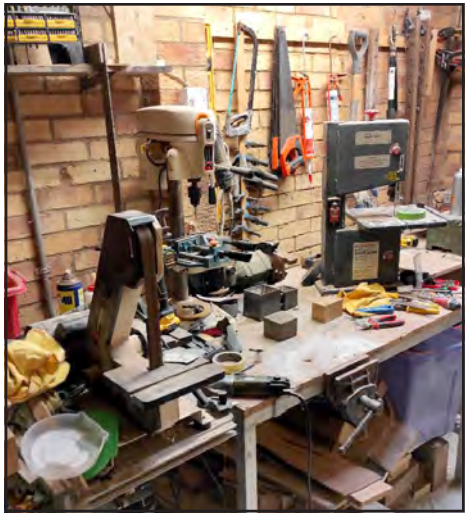
I do use AutoCAD to design certain aspects of my automata, and I also use a free gear program. On several occasions I have tried to make complete 2D drawings, but it is so complicated that I inevitably give up. I also think of improvements as I am making the piece, so now I don't bother with drawings at all. I allow an area in the automaton for each operation, then find ways of making it fit as I go along.

Over the years I have built up an audience and some of my automata have reached over 450,000 views on YouTube. Favorites are *The Ghost* and *French Maid*. My own favorite is *Stolen Kisses*, while my wife's is the *Dalek*. I made it for her one Christmas, and it comes with the appropriate sound effects.

Workshop

Some of you may be interested in seeing where and how I make my automata. My shop occupies one side of a single-car garage (**photo 9**). Most of my benchtop tools are here. The other side of the garage is shown in **photo 10**. As you see, I don't have a lot of room.

8. *Marilyn Monroe*.



9. The author's workshop, occupying half of a garage.

10. The other side of the garage.

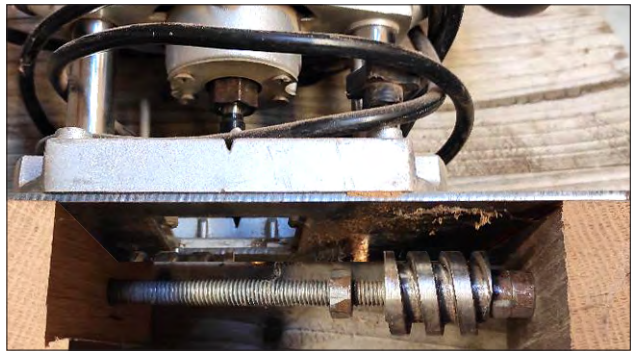
I know my workspace is untidy, but that is how I work. I have tried many times to work in a clean, uncluttered fashion, but I can't. I am so focused on what I am doing that tools and parts just pile up. The only problem is that I can never find what I want. I could have tidied it up before I photographed it, but that is not how it is.

I have several pieces of equipment that I primarily use, so they are not moved. **Photo 11** shows my Proxxon miniature table saw. This is an expensive tool, but very good. It is surprisingly powerful and accurate.

Photo 12 shows how I use a router to make my worm drives. A pre-cut metal worm that I had made is mounted on the threaded shaft. This is used as a template. To cut a new wooden drive, I install a blank round piece of 30mm diameter (1¼") wood on the same threaded shaft, using nuts to secure it. When the shaft is gently turned by hand, a 5mm diameter (approximately ¼") metal pin follows the groove in the metal template. (In the photo, this pin can be seen to the left of the worm, not engaged with it.) This enables the router to slide and copy the metal worm onto the wooden blank.

My small bandsaw (**photo 13**) is perfect for vertical cuts and also for making gears. I use it a lot. The sander (**photo 14**) is useful for 90-degree sanding. I also have a flatbed sander.

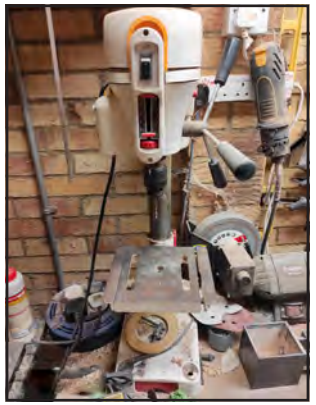
11. Proxxon's miniature table saw.



12. Making wooden worms using a router.

13. The benchtop bandsaw.

14. Vertical belt sander.



15. Drill press with depth gauge.

The drill press (**photo 15**) is essential for vertically drilling holes. It has a depth gauge, which allows me to accurately drill holes to specific depths.

My desire in writing this article is the hope that it will encourage other automata makers to attempt more ambitious projects. Remember, you can make up your own rules to suit yourself. As long as it works, it's good! A1.

Web Links

To learn more about Tim Douglas's work and see his automata in action, please visit his website, http://timdouglas-automata.com or go to https://www.youtube.com/ and enter "Tim Douglas Automata" in the YouTube search engine.

Clowning around with automata

A history of clown automata: Part 3

by Michele Marinelli, Guinness Curator, and Jere Ryder, Guinness Conservator
The Murtogh D. Guinness Collection of Mechanical Music and Automata at Morris Museum, Morristown, New Jersey, USA • Photos courtesy Morris Museum

England exported the concepts of the circus and clowning to America, where the genre blossomed. In late 19th-century America, the circus grew from one-ring horse acts to three-ring "big top" extravaganzas that travelled the country by railroad. This was the golden age of the American circus. Clown performances promised spectacular movement; frivolous, bright costuming; oversized props; loud explosives; and flamboyant makeup. These became the essential ingredients in modern clowning.

Clown Emerging from Tambourine, a rare Phalibois automaton (**photo 7a**) made in Paris, c1875, contains the elements of what made a clown a clown! The ruffled collar and cuff of the costume, the white-painted face, and a humorous action,

7a. Front of *Clown Emerging from Tambourine*, c1875, Phalibois, Paris, France.

7b. Back of *Clown Emerging from Tambourine*.

7c. Phalibois' *Clown Emerging from Tambourine*, with rear cover panel removed.

7d. Closeup top-down view of the mechanism, including hard-wood cams.

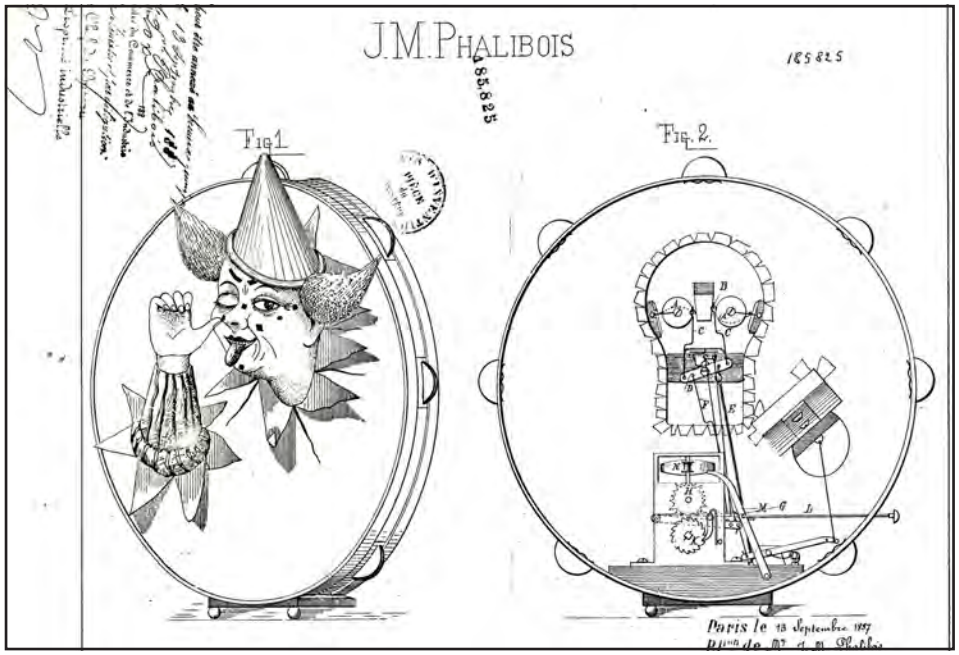
which, as he bursts through the tambourine, transforms smiles into gales of laughter.

What is difficult to see without personally experiencing this automaton is that the clown actually brushes a fly from his nose, although it appears to be a different gesture. He also sticks out his red tongue, so it may be that the hand gesture serves two purposes. This particular model was so favored by Phalibois himself that he used its image on his trade card at the time.

Viewing the rear side with the cover panel removed (**photo 7b**), the well-built clockwork motor and musical movement can be seen at the lower left in **photo 7c**. A closeup, top-down view (**photo 7d**) shows that this piece is operated by three hardwood cams (for which Phalibois is known), mounted at each side of the motor. They are attached to the same pinion, the first cam also having the escape gear so that they all run at the same rpm. This is one of the rare pieces for which Phalibois took out a patent (**photos 7e** and **f**).

In 1869, a new type of clown was unwittingly created by apprentice circus-performer Tom Belling, in Berlin, Germany. Unlike the white-face clown, the Auguste clown maintains a natural skin tone beneath painted facial features. Although there are some historical differences, the main part of the story goes like this:

Young Tom, being punished by the owner of the circus, was ordered to remain in his quarters for one month. Naturally, boredom set in. He began



7e. Right page of Phalibois's *Clown* patent.

7e. Left page of Phalibois's *Clown* patent.

experimenting with various articles of clothing and other props. Other apprenticing circus performers who saw Belling, and who roared with laughter at his outrageous attire, dared him to enter the Big Top. Unexpectedly, the ever-watchful owner pushed Belling into the ring where he "performed" for the delighted audience a series of stupid, spontaneous actions. Belling was greeted with cries of "Auguste!" which was slang for "silly" or "stupid." Embarrassed and terrified, he ran out of the tent and directly into the owner, who was also shaking with laughter.

The *Clown with Bottomless Bottle*, c1910 (**photo 8a**), is an excellent example of the Auguste clown. Fashioned by Vichy/Triboulet in Paris, the bottle is filled with water (**photo 8b**), which the clown then pours into his cup. As he raises the cup to his mouth, gravity takes over, and the water passes through a hidden tube, endlessly replenishing the bottle. It's an amusing illusion, even today!

8a. *Clown with Bottomless Bottle*, c1910, Vichy/Triboulet, Paris, France.

8b. Closeup of *Clown with Bottomless Bottle*.

Clowns and animal acts continued to be popular circus routines, as shown by this c1890 Verger/Renou automaton, *Clown de Cirque*, or *Clown Dog Trainer* (**photos 9a** and **9b**). This piece features nine animations, as the clown attempts to teach the reluctant dog to jump through a hoop. The clown moves his head forward and to the right, his right arm raises, then even higher, before being lowered, as his left arm moves the hoop up and down. The dog wags his tail from side to side and nods his head up and down, as he lifts his paws from the wooden bench (**photo 9c**).

The firm of Dehais & Laforest

Photo 9a: *Clown de Cirque* (*Clown Dog Trainer*), c1890, M. Verger/Louis Renou, Paris, France.

Photo 9b: Closeup of clown.

Photo 9c: Closeup of dog.

began making mechanical toys and novelty items in 1847. When Laforest left the firm in 1861, Dehais' son-in-law, Pierre Verger, joined the firm and eventually took it over in 1871. Verger was subsequently succeeded in 1886 by his nephew, Louis Renou (birth unknown-1958), who continued offering the same type of products—toys, novelties, and automata.

By reducing the size of his automata, Renou was able to simplify the mechanisms. This made them less expensive and more accessible to a wider public, without sacrificing quality. Renou retired in 1922 and the firm continued under the leadership of his son Ludovic and Ludovic's wife Jeanne. With automata falling out of fashion, the Renou firm created a popular doll figure around 1930. The couple continued to run the firm until 1957, when the management was taken over by their children. The following year, 1958, Louis Renou died.

While on the subject of clowning and children's toys, these *Musical Squeezebox Clowns* (**photo 10**) provided

10: *Musical Squeezebox Clowns*, maker unknown, possibly made in Germany, c1900-1920.

many entertaining hours. When children squeezed the "book" foundation upon which the four clowns sit back-to-back and hand-to-hand, the squeezebox musical movement, with a scissor-drive design, caused the clowns to crash the cymbals together while also playing music. Although the maker is unknown, this automaton is believed to have been made in Germany, c1900-20. It's amazing to think of how this toy survived those hours of children's playtime!

In closing, clowns have appeared in many guises throughout world history and have been given many different names over the centuries, but they all share one thing in common: the comic perspective and the ability to dispense humor and wit. These masters of comedy contribute to the world by making it a brighter and more joyful place!

The dangers of COVID

An unbeliever gets his just desserts

by Don Becker • Bethesda, Maryland, USA • Photos by the author

It was April, 2020. I had been in lockdown for a month. I'd finished all the unfinished automata hanging around my studio. What to do next? I felt like doing a piece about COVID. I wanted it to be funny and surprising. I also wanted it to convey the scary feeling that "COVID is everywhere. You have to avoid it. Be very careful."

My initial concept was of a person walking, moving. He would pass a wall, a tree, a fire hydrant, and the virus would pop out from behind each object. I then thought, "Nah!"

Next, I envisioned someone standing in a room with a chair, a lamp, a picture on the wall, a fireplace. When the crank was turned, tons of virus would come out and stick to him like magnets. I couldn't quite figure out how to do that.

Then I came up with a fellow standing alone on a platform and, when he drops his mask (so certain that he is safe), from out of

A youth is skeptical of the dangers of COVID.

He drops his mask in denial of common sense.

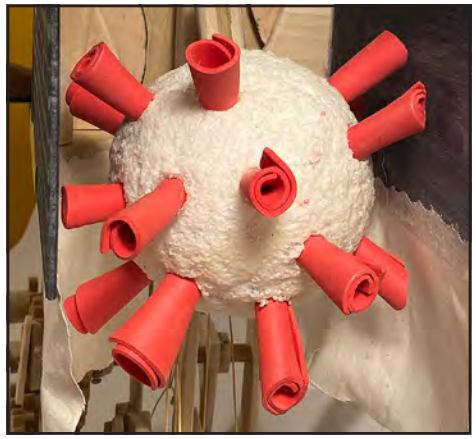
The COVID virus immediately clobbers him, as his friends scold.

1. The figure, crushed by the virus, collapses, telescoping into himself.

nowhere a huge coronavirus flies in and crushes him, like the giant foot that crushes things on Monty Python. The figure would be made to collapse so that all you would see were his eyes and his shoes.

That I figured I could build.

I tried to draw out what I was going to do, but I only got as far as drawing the fellow. I got stuck trying to figure out how to hide the virus and get it to crush him. I wanted a figure standing alone on a plank. The virus could be hidden beneath and could swing up from behind and crush him. Maybe the floor could open up behind him and the virus could rise through it



2. The virus was made of a Styrofoam ball with Fun Foam projections.

and crush him. The difficulty was in trying to design a huge, hidden virus among all the mechanics. It seemed too complicated to figure out on paper or to prototype, so I decided to just start building. That is often how I work.

Problem solving and construction

I built the figure first, making three papier-mâché tubes, each fitting inside the next. The smallest tube is his eyes, the middle is his head, and the largest tube, his torso. The middle-size tube has eyeholes cut out so that the pupils on the smaller tube, when rotated, would move his gaze from side to side. The middle tube (the head) collapses into the larger torso tube. The figure's legs were made

of fabric so they would easily collapse into nothing.

There is a 1⁄16" (1.5mm) rod attached to the small eye tube, which travels through a 1⁄8" (3mm) square tube attached to the large torso tube. This was the easy part and it worked great. His eyes moved and he collapsed beautifully (**photo 1**). I drilled a hole through a piece of poplar for the base, then I sat and stared at it for a very, very long time. How to make the virus appear, crush him, and return to its hiding place?

I made a virus out of a Styrofoam ball. I slightly crushed the surface and covered it in several layers of glue to form a hard shell. I rolled up pieces of red Fun Foam and stuck them into the ball to become whatever those things are called that stick out of the virus (**photo 2**). I then attached a stick to the virus and began moving it on different paths.

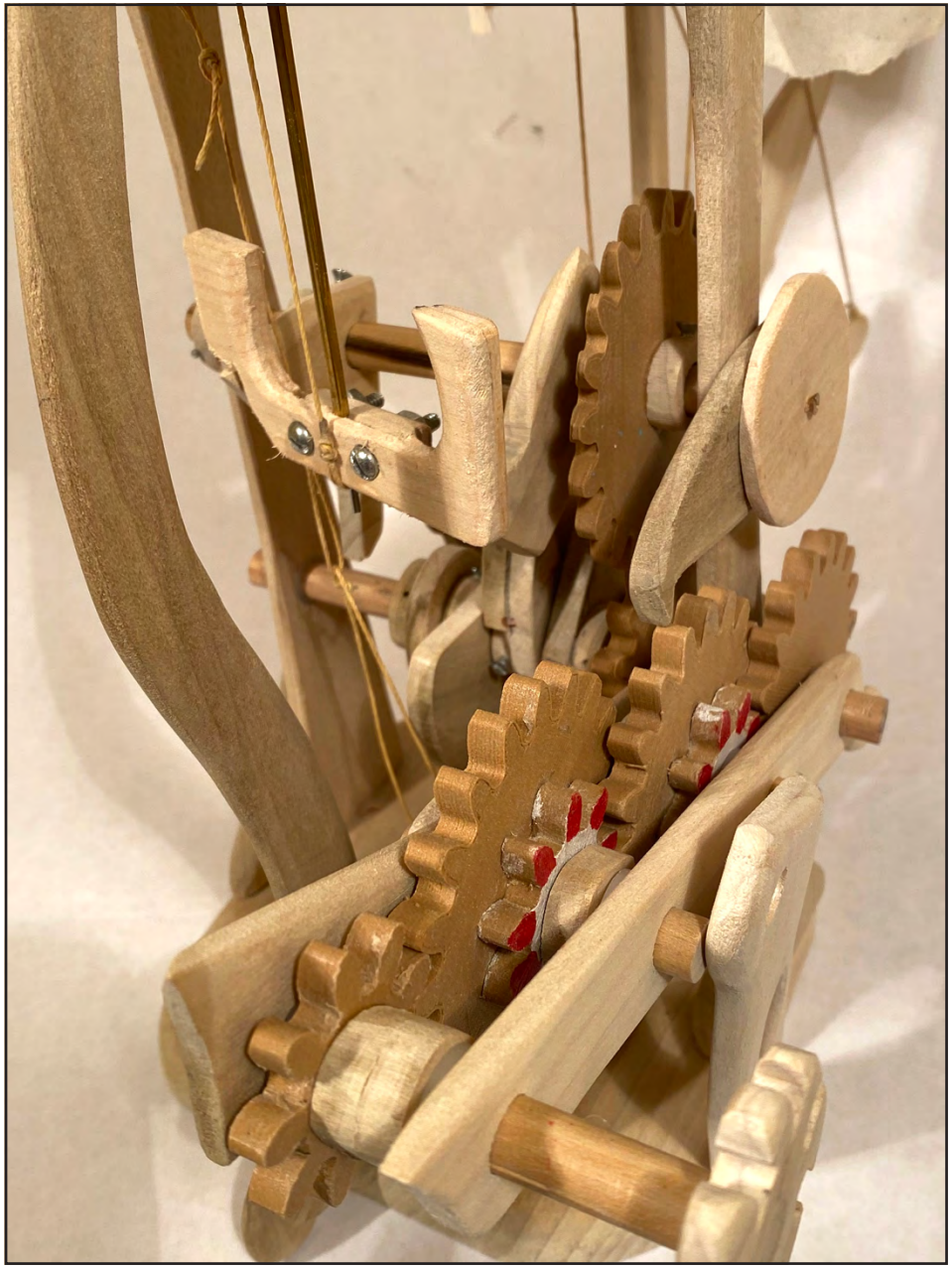
I tried to establish the pivot point of the virus's swing arm just below the platform level. That way the virus would swing up from behind, hit him on the head, and he would collapse. The problem was in determining the ultimate resting place of the virus. With the pivot point just below the platform level, the virus's resting place would be way out in front of the figure. In order to keep the virus near the figure at all, the circumference of the virus's path would be extremely large, requiring a *very* long platform for the figure to stand on.

3. This is the space behind the figures (sans virus) in which the virus hides, camouflaged by the black-painted brick walls above and fabric curtain below.

At that point, I realized that if I moved the pivot point above the platform, I could then figure out the shortest possible height for the pivot. I would have to disguise the pivot point behind the figure somehow—maybe through a slot on a picket fence or something in the background. The solution can be seen in **photo 3**.

I then built the swing arm for the virus. I also built a scissor lift and attached it to the swing arm. The scissor lift was necessary because there wasn't going to be much space for the distance the swing arm needed to travel. I could shorten the necessary travel path based on where I attached the lever or string (powering the virus) to the scissor lift. A good bit of force would be needed to thrust the virus around its path.

Once I figured this out, I started building the levers, cams, and gears that I needed. I used poplar because it was what I had in my studio. I used to make wooden gears, but I now print them using a 3D printer (**photo 4**). It's definitely



4. Closeup shot of the hand-cranked mechanism. Most parts are made of wood but the gears are 3D printed.

5. As the virus crushes its hapless victim, speech bubbles pop out from his companions behind, admonishing him to "Puleez! Wear your mask!"

easier and less fine tuning is needed to get them to work. That gives me more time to fuss with the levers and cams.

Making the levers and cams went surprisingly quickly…how about that! Experience helps. I needed to set a number of cam movements. First were the eyes moving from side to side. Second was the mask dropping. Third was the virus coming from behind. Fourth was the figure squishing when the virus landed on him. Fifth was the virus returning to hiding. This was going to take a bunch of cams in a tight space.

It all worked well until I got to the eye movement. That mechanism got in the way of the other cams. I ended up setting that mechanism on its own crankshaft and tying it into the main crankshaft using gears.

6. The mechanism that activates the speech bubbles as the virus's arm swings up.

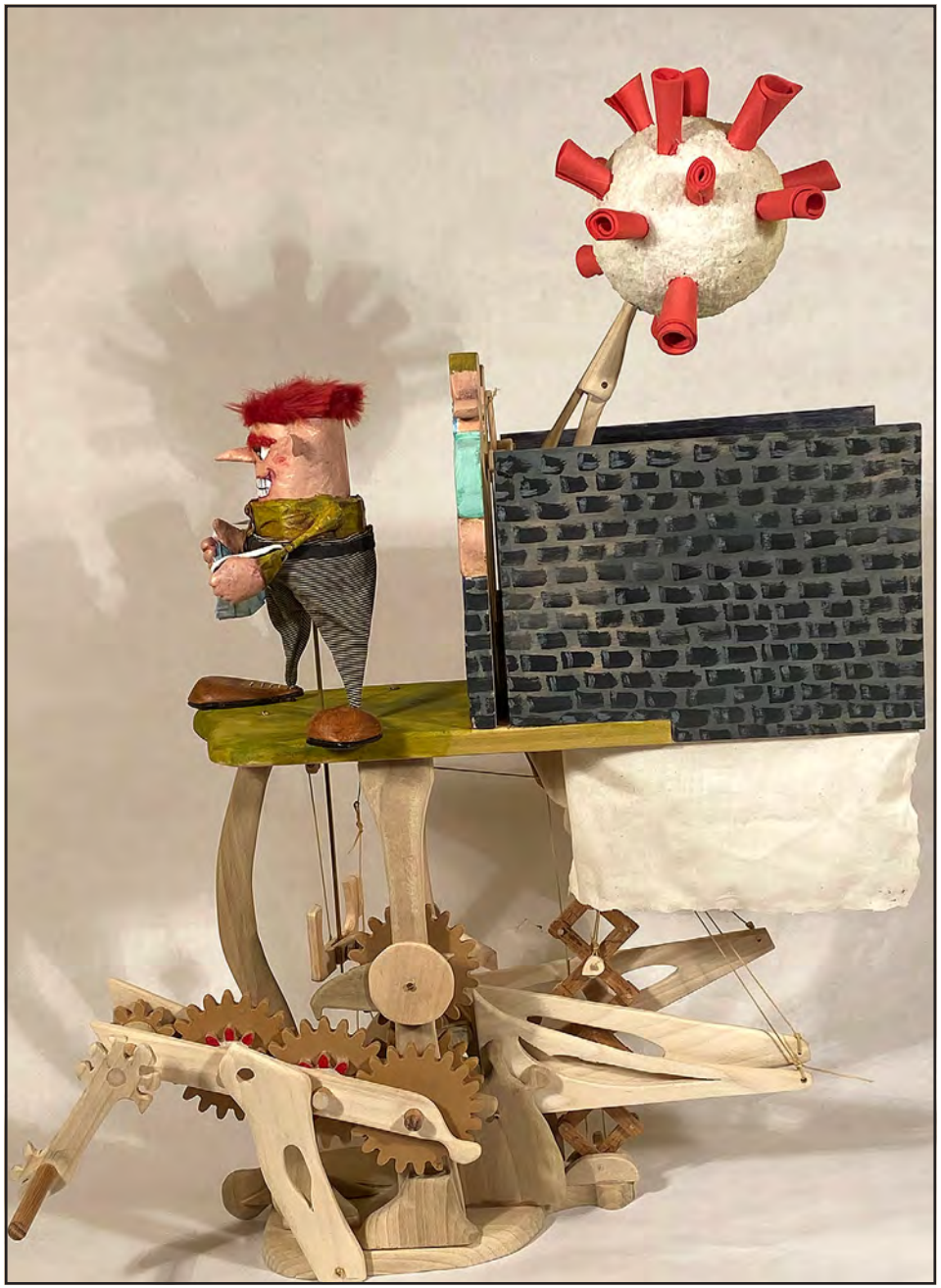
Background for the figure

At this point, I had not figured out the background for the figure. Something had to hide the virus and the swing arm. I wasn't crazy about the fence idea. Perhaps a group of people in masks behind him?

Originally, I had thought that a sign could pop up when he got crushed, saying, "The virus is gonna get'cha if you don't watch out!" It occurred to me that a group of people behind him could scold him using little pop-up conversation bubbles (**photo 5**). Somewhere, I had seen a clever automaton where the builder used these little bubbles for speech.

How would this work? I didn't want to add another cam or lever to my already-crowded crankshaft. I built the crowd and mounted it to the platform. I realized that I could install a lever that, as the virus's arm came over the crowd, would swing the speech bubbles out from the sides (**photo 6**)! Perfect!

After that was all built, I mounted the cams in the right spots to set the timing. Everything worked (**photo 7**)! On to the next automaton!



7. The virus in mid swing, about to descend on the maskless miscreant.

Video Link

See the recalcitrant mask wearer get what's coming to him: https://youtu.be/MoDV-4FjR0.

Making a cat from scrap

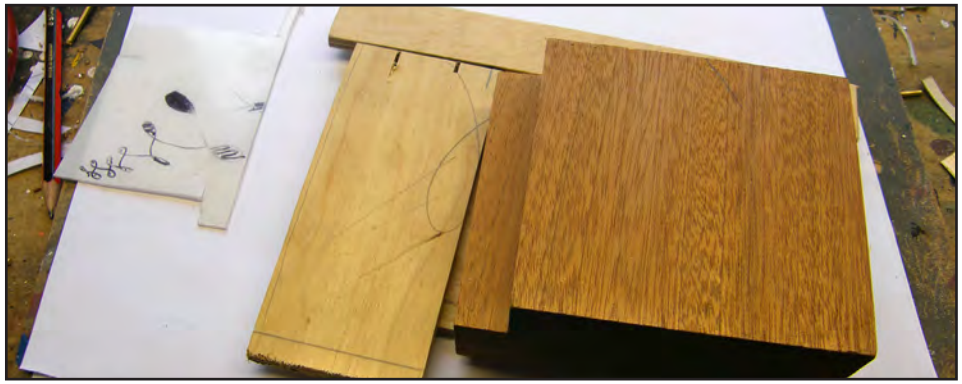
Try this simple one-evening project

by Lee Hutchinson • Hope, Derbyshire, United Kingdom • Photos by Poppy

I've always liked the cat on the poster "Le Chat Noir" by Theophile Steinlen. I also enjoy those automata where a mouse goes in circles and the cat almost, but never quite, catches it. The automaton presented here (**photos 1a, 1b**) is my contribution to the niche of cat automata.

The premise was to use as few tools as possible and the build time, start to finish, was to be around ninety minutes. To build your cat, try to find, as I did, bits of scrap or recycled wood (**photo 2**).

1a, 1b. With a turn of the crank, this simple cat licks its paw and moves its tail.



The author's cat was made of scrap wood. He used Baltic birch plywood for the cat and a block of sapele for its perch.

Materials list for the cat automaton

- 6mm (¼") birch ply and a lump of sapele, mahogany, or similar wood
- 1.0, 1.5, and 2.0 mm drill bits (1/64", #73, 1/32", respectively)
- Coping/fret saw
- Hand saw
- Black and white paint
- 2mm (5/64) brass rod approx. 4" long (100mm)
- 2 machine screws, M2 x 15mm (.591") long
- 3 M2 washers
- Length of 1mm brass rod (5/64)
- CA cement (super glue) and activator

Construction

Using the pattern provided, cut out the cat's body, head, and tail. Sand them smooth and drill the holes indicated on the pattern. Screw in the M2 screws, as shown in **photo 3**, placing a washer between the head and body, and ditto with the tail. Ensure the head and tail are free to move but are a snug fit. If the screws come through the other side, now is the time to file them flush.

You'll notice in the picture that I have been lazy and sliced through the cat's leg, rather than piercing the piece and threading the fretsaw's blade through to make the cutout. If you do slice through the leg, just force some super glue into the cut, then spray it with activator. This will fill the gap. Two minutes later, sand it down and you would never know that it was there.

Linkages

I've removed the hard work for you by spending many frustrating hours working out exactly where the holes should be, as well as the length of the linkages to join them. I did this, not with math or cunning devices, but by drilling lots of holes until I found what I wanted.

Perspex (Plexiglas), 1mm thick, is an ideal material for the links. If that's not available, thick card or possibly the plastic from a carton or yogurt pot would suffice. A short piece of 1mm rod set into the cat's head and another set into the tail will be the hinge pins for the short link (**photo 6**). Once you're happy that the cat's head and tail are free to work, bend the short rod in the tail over into an "L" shape

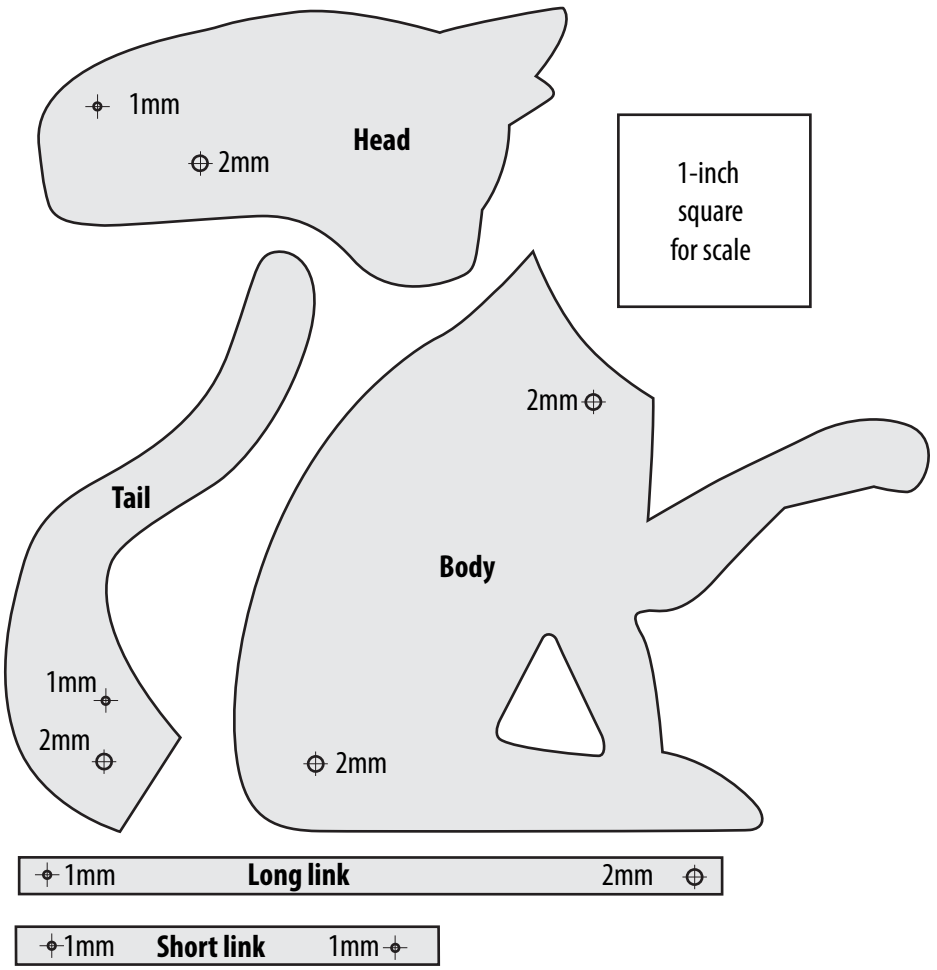


Figure 1—Cutout pattern for cat parts

3. Head and tail are screwed to the body.

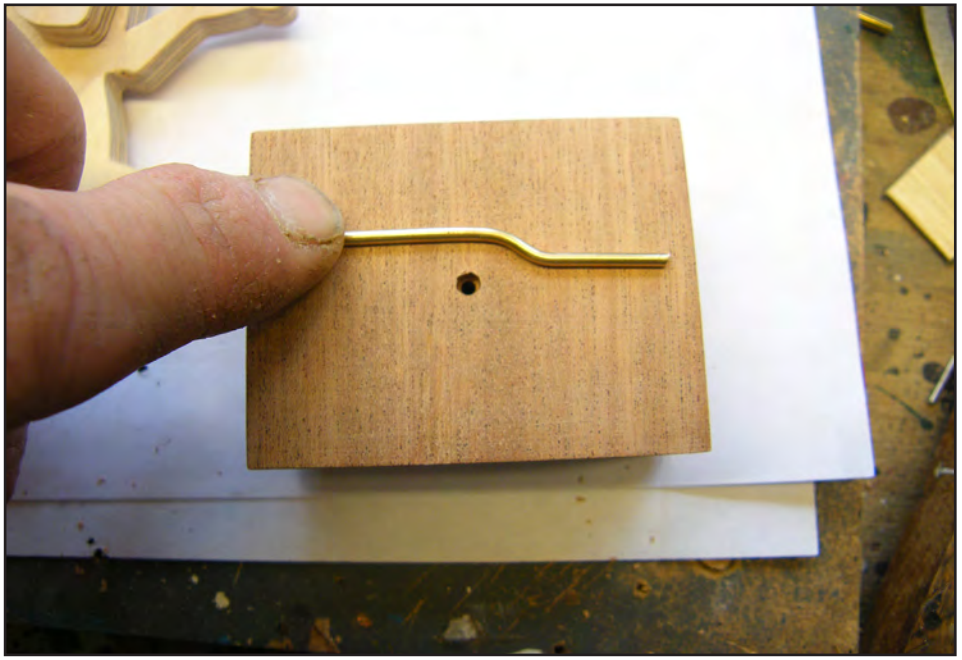
to hold the link in place. Don't bend over the rod in the head yet.

Do a little sanding of the base of the cat to ensure that it's flat and square for gluing. Now is the time to disassemble the cat and paint it.

Block

While the paint dries you can work on the base block. The block should be about 3" long, around 2" deep, and 2" high (7.6 x 5 x 5cm). I added a little detail by chamfering the front edges. Find the center of the side of the block and drill straight through with a 2mm bit. Work the drill a little so that the rod passes smoothly through, but avoid making it slack.

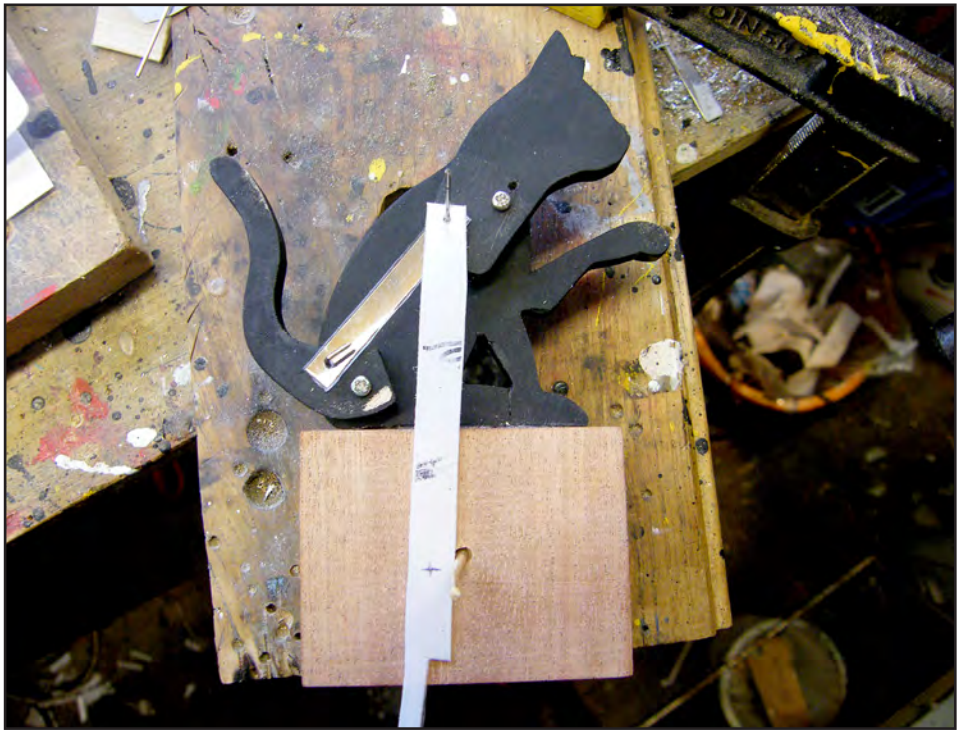
If you're going to do any artwork on the block, now is the time. I have a set of alphabet stamps that I like to use.



4. The crank to which the link is attached is bent to the shape in the photo.

5. Once the rod has been inserted into the block, the crank handle is bent to shape on the front side of the block.

Head and tail are linked. The links pivot on short lengths of brass rod.



7. The final link to the head, made on the back side of the block.

Crank and handle

Bend your piece of 2mm brass rod as shown in **photo 4** to form the small crank that moves the cat. The throw of the crank is around 3 to 4mm (.118-.157"). There's room for adjustment once the cat is in place. Thread the rod through the hole in the block, with the offset leg at the back, then rotate the rod to ensure it's free to move. In the front of the block, bend the rod over and form it into the crank handle (**photo 5**).

You're now ready to glue the cat in place. The cat needs to be positioned so that its tail and head are flush with the back edge of the block. I'm impatient, so I use super glue and activator.

Once the cat has been set in place, add the long link from the offset crank at the back of the block to the short piece of 1mm rod set into the cat's head. When you are satisfied that all is well, bend the 1mm rod into an "L" shape to hold it in place (**photo 7**). At the crank end of the link, I used an M2 washer with a blob of super glue, sprayed with activator, to hold the link in place. If I had used the lathe, I would have made a little collar and soldered it in, but the ethos was to use as few tools as possible.

A touch of white paint on the tail adds some character to the cat, and oil on the block brings out the wood grain. Have a go at building this automaton and you will have a fine gift for the cat lover in your life.

Web Links

To see the cat and other work by Lee Hutchinson, visit his Etsy page at https://tinyurl.com/leehutchinson

Rotch-O-Mat

Making automata is just one facet of this artist

by Roger "Rotsch" Weber • Niederlenz, Switzerland • Photos by the author

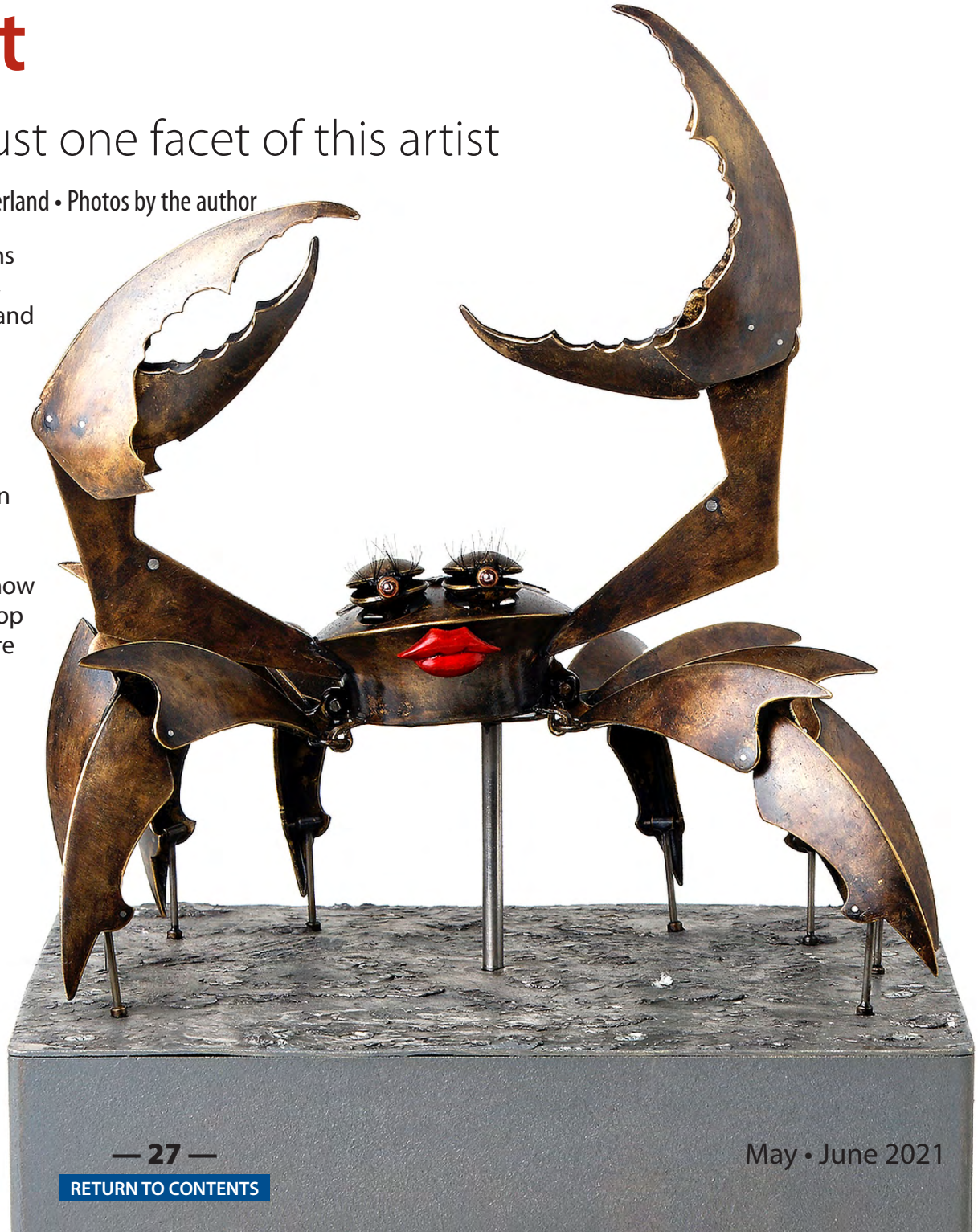
Although I was trained and still work as a jeweler, I have long had an interest in automata. This part of my creative work began in my childhood. The Caran d'Ache shop windows fascinated me, with their animated stuffed bears or plastic Indians who could move an arm.

Even as a child I drew a lot and made things, mostly animals and people, and, later, whole comic stories. These influences can still be seen in my jewelry and automata. Inspiration came from nature, second-hand shops, animated films, and more. This also led to my independence.

After a four-year apprenticeship, and working in the jewelry profession for four more years, I took the daring step into self employment. I opened a small shop on the edge of a medium-sized town. To attract customers, I regularly made special shop-window displays, often with moving scenes powered by motors. As a result, over time I received commissions from scenographers, museums, theaters, and private individuals who wanted a moving scene, a mechanical stage set, or a crank-operated machine on a particular theme.

Twelve years ago I gave up the shop. I now have a great workshop in an old factory. Here I have more time for my projects and can work on them undisturbed.

Under the label of Rotsch-O-Mat, I produce unique jewelry pieces, moving figures, automata, and poetic machines. My work is intended make



1. *Dancing Klara*.

2. *Acupuncture*.

3. *Chatterbox*

4. *Chatterbox* detail.

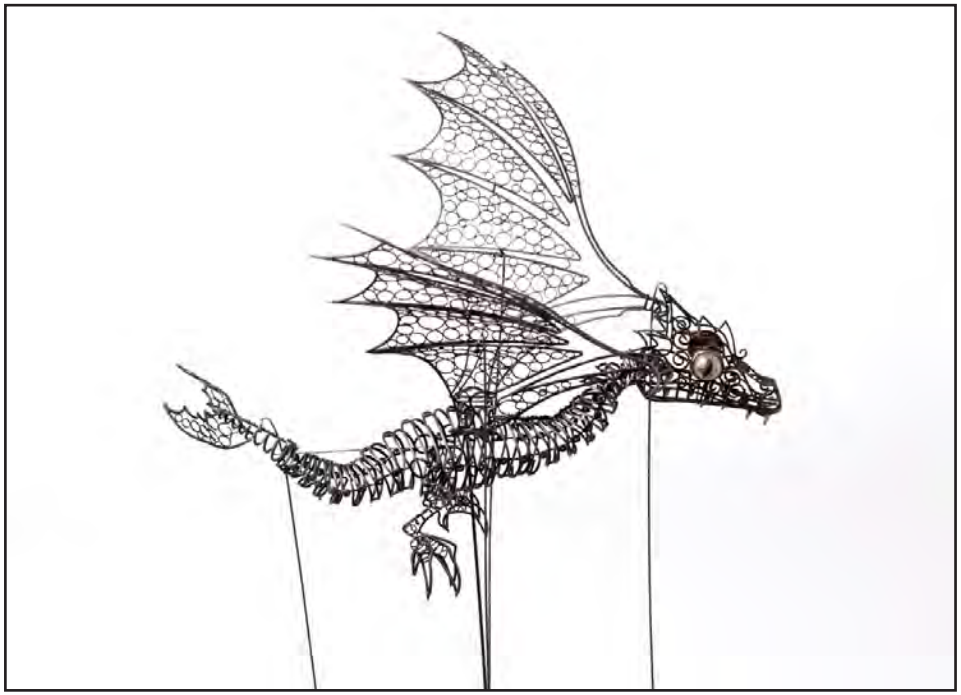
you stare, think, or produce a smile. Since 2019 I have also been running my own teaching studio, with eight work stations for jewelry and automata courses and workshops.

In the summer I run a weekly course on making coin-operated machines in the Swiss mountains. To sell my jewelry and coin-operated machines I participate in two or three exhibitions per year, or customers visit me in my workshop.

Teaching

For 23 years I have been teaching one or two days a week. When it comes to teaching, I must take another short trip back to my childhood. My father is a gifted craftsman and perfectionist. As a mechanic-constructor, he planned and built everything in and around our house, but he was not interested in passing on his skills. I was always just a handyman and was never allowed to hammer in a nail or sand a board myself. In adulthood, however, I realized that I had learned a lot from him by watching. And, thanks to those experiences, I also developed the patience and calmness to teach people a craft.

In 2000 I had my first opportunity to assist in a course by Hada Ahmed, whom I got to know during a project with Helvetas (a Swiss development



5. *Flying Dragon*.

program) in Agadez, Niger. In 2004, my first weekly course, "Cheeky Automata," took place there. In 2016 and 2017 I was again allowed to lead a course, this one called "Moving Figures." I am always surprised at how diverse the students work turns out to be.

In 2016, I was asked to develop instructions for a simple, hand-cranked automaton for *Kiludo*, a Swiss children's creative magazine. The task: Children from the age of eight should be able to build an automaton as independently as possible with easy-to-obtain materials. I created instructions for a "box animal," which are still being used successfully. I am currently working on smaller crank automata with micro-welded iron wire figures.

Automata

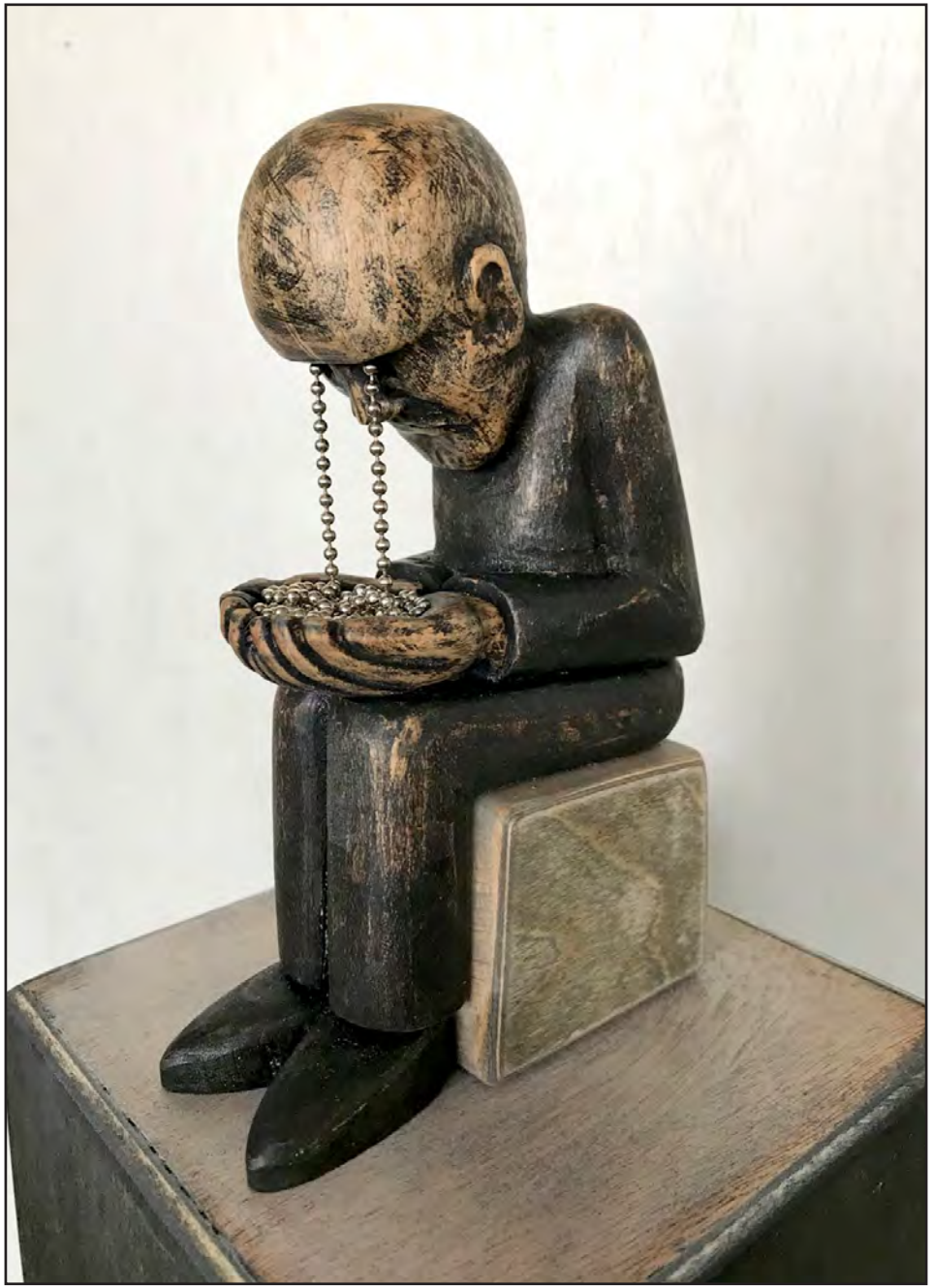
One of my first automata, 25 years ago, was also a shop-window display. Figures were driven by a drilling machine, which gave up the ghost in a plume of smoke after only 12

6. *Dancing Frog*.

days of continuous operation. Since then, automata have not let me go and I often tinkered with such "problems" in my free time. Once I start, I can hardly stop until everything moves as I imagine it. With increasing experience, my objects became more and more complex and, in the meantime, I learned to better estimate how to achieve a desired movement. An invitation in 2016 for a solo exhibition at the Gugelmann Museum in Schönenwerd finally confirmed in me the decision to give this area of my work an equal part, next to the jewelry.

Daily life now provides most of the inspiration for my work. This can come from a visit to the zoo, a funny or tragic experience, a headline in the press, etc.

For years I have enjoyed working with wood. I usually make figures for my automata from beech or boxwood. Since I am not good at carving, I work on the rather hard woods using saws, files and routers. I have also acquired a few larger woodworking machines for this purpose. For example, I can first saw blanks on the bandsaw, then pre-sand them on the belt sander. I also use acrylic and castable plastics for press molds or objects that should have little weight, e.g. hair ornaments.



7. *Endless Tears*.

Since I cannot bring myself to throw away a leftover piece, I have a huge stockpile of material. Every few months I have to sort it again to keep it in order so that I can find small parts when I need them. When I'm in the mood for it, even this work is fun!

I prefer crank-driven drives because the joints, drive shafts, and their bearings are not exposed to as much wear and tear as those driven by motors. You crank only as long as you want to see the figure in action. If you forget to turn off a motor, the mechanics can suffer, or I have to install complex electronic timers, which take more space and make an object more expensive.

Years ago, when my son was still small, we went on a holiday to a North Sea island a few times, where he used to catch crabs on the beach. The movements of these animals fascinated me and inspired me to build the crab *Dancing Klara* (**photo 1**).

When I had severe back pain a few years ago, acupuncture was recommended to me again and again. I was told, "You can hardly feel the needles." When I decided to do it, the Chinese doctor hit

8. Lizard in progress.

9. Lizard eyes under construction.

a nerve so hard with the third needle that I jerked around on the massage table! This led to the automaton *Acupuncture* (**photo 2**).

Chatterbox (**photos 3** and **4**) is made of beech, painted with acrylic. The woman has an old-gold ring and a raffia hat. When cranked, she makes phone calls and babbles.

Last year I acquired a micro spot welder. This is actually intended for delicate jewelry repairs and for tacking parts but I discovered that plain, black-iron wire from the garden department or hardware store welds easily and extremely well with it. Since then, I've been making some of my moving figures out of iron wire. See **photo 5**, *Flying Dragon*. I drew the round wire through a draw plate into a square profile, then bent all the parts to shape. I formed eyelets, then welded it all together. I worked on this piece for 112 hours. The automaton is powered by a 24V motor.

Dancing Frog (**photo 6**) is one of my latest works. A wind-up clockwork motor makes the frog dance like Michael Jackson.

Another recent work is *Endless Tears* (**photo 7**). I made the figure out of beechwood. The flow of "tears" is driven by a 12V motor.

I am currently working on a lizard (**photos 8** and **9**), which will have moving eyes, but I am waiting for a surge of energy to continue working on it!

Web Links

To see more of the author's work, visit his website at http://www.rotsch-o-mat.ch

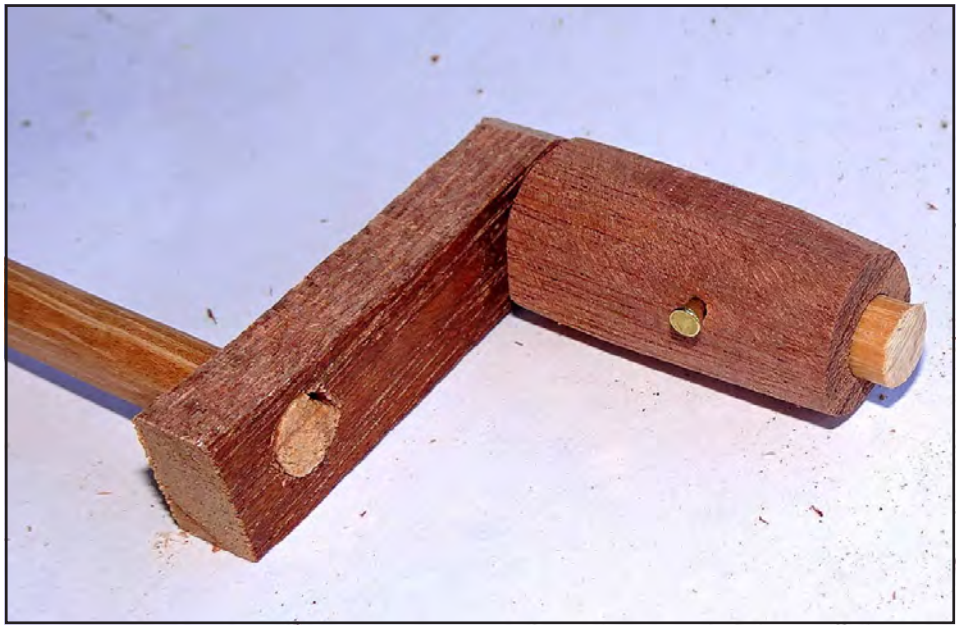
Making revolving crank handles

Rotating handles on your automata make operation easier

by Ivan Morgan • Lewes, East Sussex, United Kingdom • Photos by the author

When I operate hand-cranked automata, I have no difficulty in letting the handle slip through my fingers as I turn it. Other people, however, and especially children, seem to have great difficulty doing this. They grip the handle tightly or their sticky fingers prevent the handle from slipping around. Because of that, I now try to fit a revolving handle to any new automaton that I make, and I've even been retro-fitting them to some of my older models.

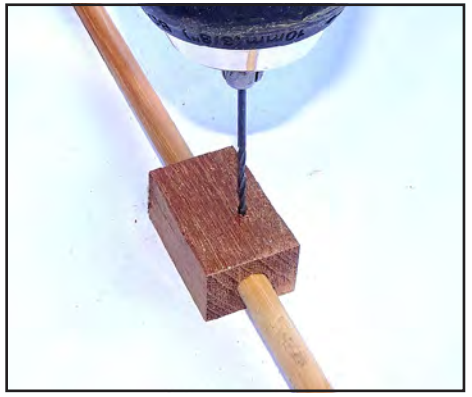
Over the years I tried various ways to make a handle that could be gripped firmly but would still rotate easily. I eventually came up with the following design.



Handles that rotate on their shafts are more comfortable to use and add a bit of sparkle to the finished piece. The author tells how he makes his.

Assuming that you are using a 6mm (¼") dowel for the handle, take a piece of hardwood about 2cm (¾") long by 1cm (⅜") square and drill a 6.25mm (⁹⁄₃₂") hole through it the long way (**photo 1**). Then insert the dowel and drill a 1.5mm hole (1⁄16") through the side of the squared piece so that it just goes through the edge of the dowel (**photo 2**, **figure 1**). To place this hole, I just line up the drill by eye, which usually works well. You could also make a paper template of the end of the block, showing the position of the dowel hole, and lay that on top of the block to mark the position of the edge of the dowel. However, I think that would probably be less accurate than lining the drill up while simply viewing the block from the end. If you don't get it in a perfect position the first time, you can always drill another hole! I am a trial-and-error advocate!

1. A hole is drilled through a block of wood that is to become the handle.



2. A smaller hole is drilled through the side of the block, just at the edge of the inserted dowel.

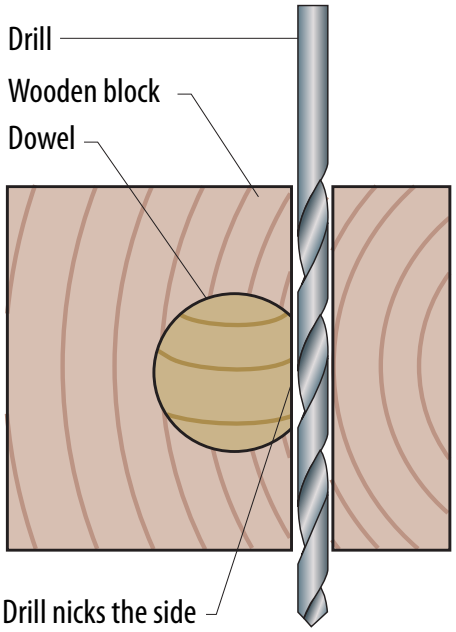
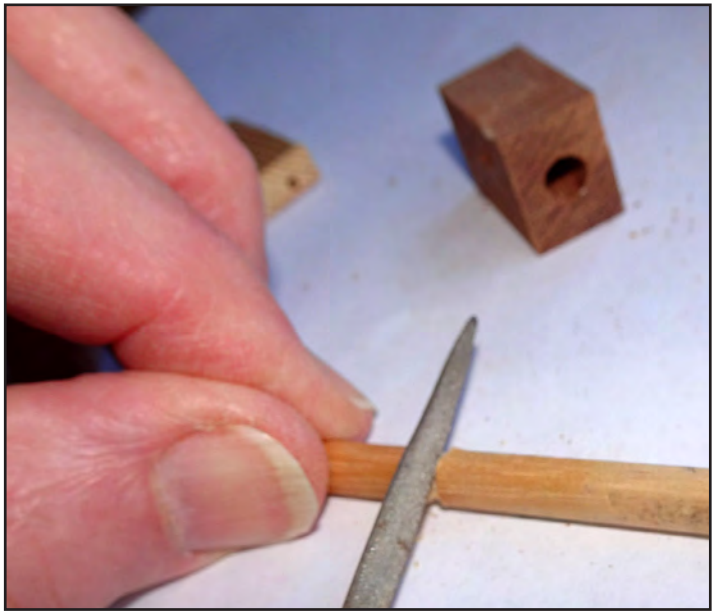


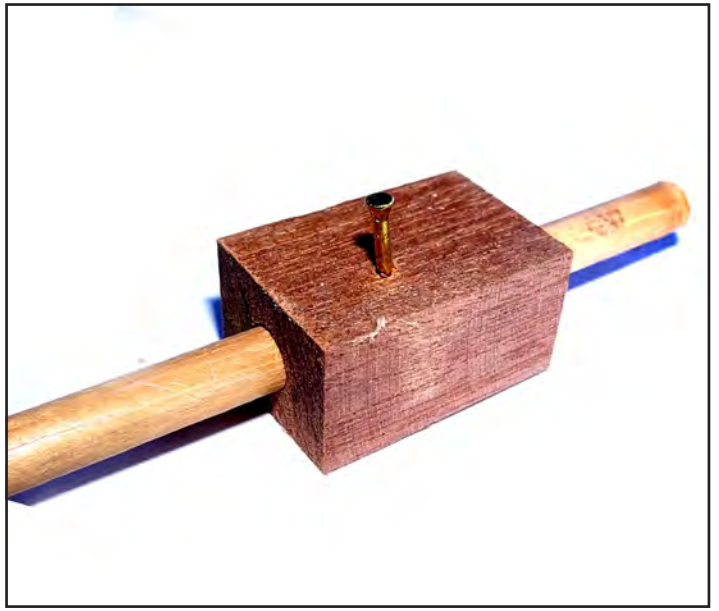
Figure 1—Drilling the dowel

3. Wood is removed between the lines with a sharp knife.

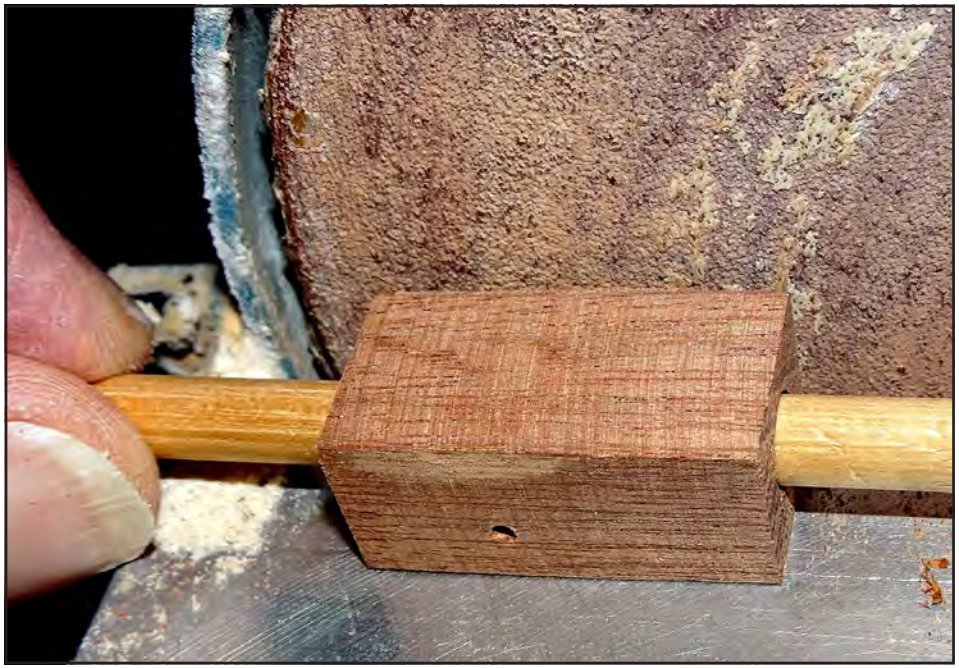


4. A file smooths the groove.

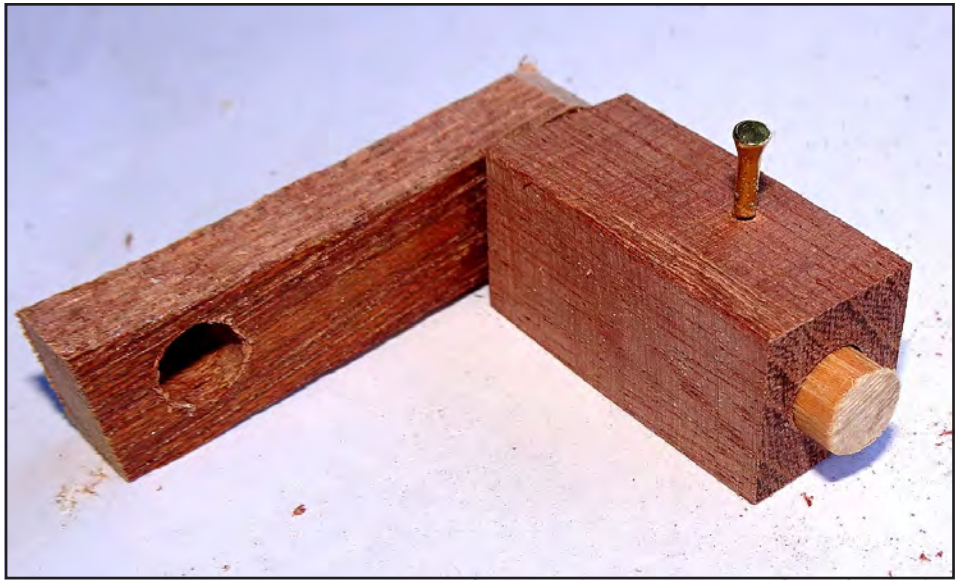
5. The finished groove.



6. A brass pin is inserted to retain the handle on the dowel.



7. Sanding the block.



8. The finished handle with the block left square.

Remove the dowel and saw two lines around it, one on either side of where the drill has marked it. Make these about 2mm apart (5⁄64") and 1.5mm deep.

Chip out the wood between the saw cuts with a scalpel or other sharp knife (**photo 3**), then smoothly file down the groove around the dowel (**photo 4**). The groove should end up being 1.5mm deep all the way around the dowel (**photo 5**). Next, assemble the square block and the dowel again, lining up the 1.5mm hole with the groove. Insert a 1.5mm brass pin (or 1.6mm for a tight fit—**photo 6**).

The block should now revolve freely around the dowel. If it doesn't, remove the dowel and smooth the groove some more, ensuring that it is deep enough all round. Once the square block rotates smoothly, it can be carved and sanded as much or as little as you want for your model (**photo 7**). It can be left square (**photo 8**), but I usually sand mine down to leave it about 8mm (5⁄16") in diameter (see **lead photo**). If the pin is loose, a spot of glue will prevent it from falling out. Cut off and file down the ends of the brass pin. Operating the automaton is now much easier and more satisfying.

XiangMu's Automata World

Designing Cams

by XiangMu • Shijiazhuang, Hebei Province, China • Photos and drawings by the author

In 2018, I saw a video on the internet about a marble machine. It was a complicated mechanical device, with marbles shuttling on wooden tracks, constantly triggering various mechanisms. This video shocked me. It made me feel like I was that marble, breaking through different stages of my life. Influenced by this machine, I began to learn how to make wooden machinery.

For most people, automata are toys. In my opinion, an automaton can be an expression of thought and emotion. I see automata as a form of emotional sustenance. During the past two years, I have been learning and studying other people's work, accumulating mechanical knowledge and production experience. I have also tried to make a lot of toys. However, these toys are not satisfying because they do not express my thoughts and emotions. So, over the past two years, I have also been exploring ways to express myself.

In January, 2021, I saw the work of Japanese automata artist Hideki Fukuda on his Twitter page (*https://mobile.twitter.com/puchuco709*). His pieces are typically small, metal figures. A figure is mounted on a plain tree stump and the action is simple. Even though the puppet's action is simple and the production is rough, it moves me because its performance makes me feel both sad and happy.

Emotion—that's what I've been looking for. I needed to add real emotion to my work. Puppet performance is abstract, but the output of emotion is real and can be experienced by everyone, allowing people of different cultures and nationalities to feel the same thing. With that in mind, I began this year's first creation (**photos 1-6**).

It's called *Cover Up*. An abstract figure sits alone on a high platform, holding a mask with

XiangMu's *Cover Up*.

1. The despondent figure sits alone on a high column.

2. He looks down and begins to raise a mask to his face.

3. The mask is fully on. The linkage of the arm is clearly visible.

4. We can see that the mask is smiling, covering the figure's pain.

a smiling face. The puppet's state is sad. It tries to put on the mask, but gives up. After hesitating and thinking, it finally puts on the mask. Every adult can understand this scene. We all want life to be beautiful, but there are always many unsatisfactory choices in real life. In the face of reality, we compromise again and again. We do what we must do, though we do not want to do it. We use a smile to cover our pain, but it's not a behavior that needs to be hated and rejected. I think it's a skill that we must learn in the process of growing up. The best way to face life is to smile with the pain.

For this piece, I used wire and cams to control the puppet, a more traditional mechanical structure similar to a marionette. In learning the culture of automata, I realized that their mechanical structure can be divided into two types. One is the traditional form that controls a figure. It smoothly completes complex actions through the interaction of cams and thin lines or wires, such as a writing robot, a singing bird, or an archery robot. This technology was widely used in the 18th and 19th centuries.

The other way is through a simple mechanism that achieves a rougher puppet action. At present, many popular automata from Europe and America adopt this second mechanical structure. It is also the one I have used most.

Here, I will share with you the principle of achieving motion with a cam, and how the cam might be simply designed. My

5. The automaton is controlled by five closely spaced cams.

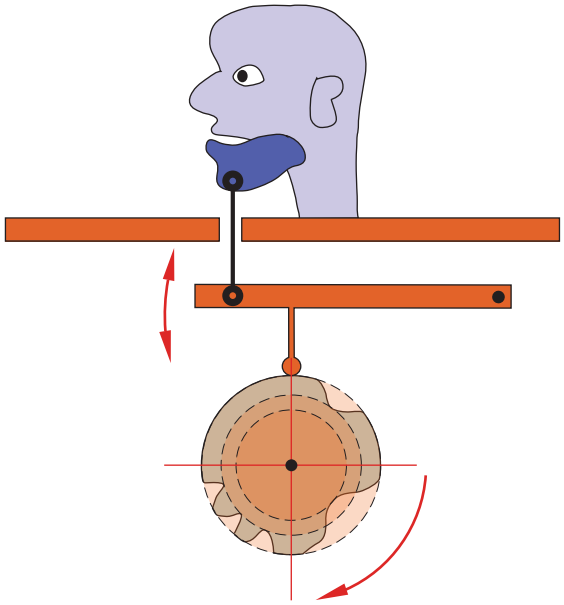
method is rough and inaccurate, which is quite suitable for people who don't use computers to design automata.

I have prepared a model, shown in **photo 7**. From the drawing (**figure 1**), you can see that the action is composed of two parts: a cam and a strut (also called a cam follower). There are many uneven curves along the edge of the cam, which represent certain types of information. This information is transmitted to the puppet through a supporting rod, and the puppet will move according to the instructions of the cam. But how does one understand and design these curves?

First of all, you need a simple understanding of how the curve and strut work together. When the curve descends, the strut will also descend. Likewise, when the curve rises, the strut will also rise. The duration of the movement is determined by the length of the curve.

The supporting rod is connected to a specific active joint of the puppet. The movement of the supporting rod can be affected by adjusting the amplitude (height or depth) and length of the curve on the cam, thus affecting the movement of the puppet. The

6. Wires from the struts, or cam followers, are connected to the figure's various body parts. The weight of each part returns it to its resting position.



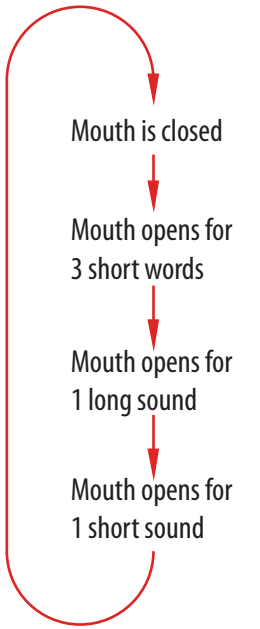


Figure 1

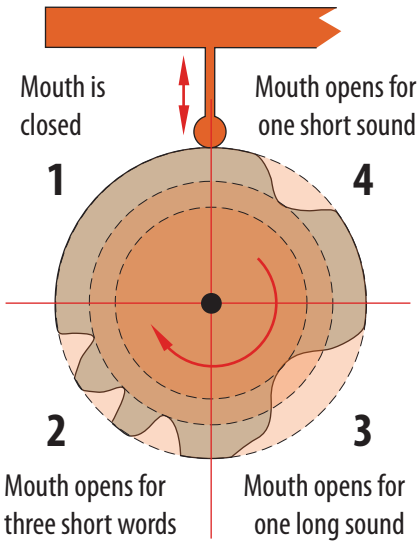
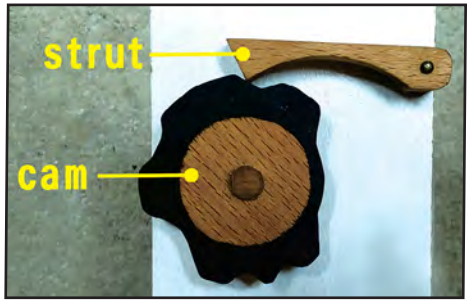


Figure 2

the movement of the mouth at different frequencies and amplitudes. This same procedure can be used to make cams that will produce a variety of different motions. Try it.



7. Model showing the relationship of the cam to its strut (follower).

more pronounced the curves on the cam, the more the puppet moves.

I'll show you how to make a cam by making a speaking head (refer to **figures 1** and **2**). I started with a 0.8cm-thick (.315") board. On this, I used a compass to draw a circle with a diameter of 10cm (3.937") on the board. Next, using the same center, I drew two more circles, one 9cm (3.543") and one 8cm (3.149") in diameter. Then I used a ruler to divide the three concentric circles into four equal parts.

I then used the circles to draw the cam curves according to the desired frequency of movement, the range of motion, and the order of motion of the puppet's mouth.

I designed the curves, with the circles moving clockwise, within the four zones. In the first zone, the speaker is silent, so I made no change in the outer circle. In the second zone, he speaks three times in a row. These needed to be relatively short words, so I made three notches in a row. In the third zone, he opens his mouth wide, so I deepened the depth of the curve and made it longer. In the fourth zone, the figure opens his mouth just a little, so I made a shallow notch. In this way, I could control

Video Link

A video of *Cover Up* is posted on YouTube. Click to watch it: https://youtu.be/mR96m-8M3u7s

LEGO AUTOMATA

A conversation with Andrea Girotto, a.k.a. Jolly 3ricks

by Teun de Wijs • Amsterdam, Holland • Photos by Andrea Girotto

Andrea Girotto, celebrating Halloween and his love for bricks with his latest model, *Hocus Pocus*, which was built as a tribute to Keith Newstead's *Witch* automaton.

Even within the abundance of LEGO builders making incredible things, true quality is still easily recognizable and the cream will rise to the top. Given that, I was delighted to see that the amazing musical models of Andrea Girotto, which I have always believed to be criminally underrated, have recently attracted some well-deserved attention within the brick-building community. His work has even been featured by the LEGO company.

Girotto is better known by his alias, Jolly 3ricks. According to him, "3ricks" could stand for "bricks" as well as "tricks." He draws inspiration largely from popular themes but his approach is always original and his perfectionism shines through in his models. His constructions are not only jolly, but also ingenious, well crafted, attractive, and highly charming.

Despite the recent surge in exposure, Girotto remains decisively modest and considers himself still very much a student of his craft. I am very happy that he agreed to answer a few of my questions for *Automata Magazine*.

T: Hi Andrea, thank you for taking the time to talk. Would you tell us a bit about yourself?

A: On 16th April I turned 41. I live in Tortona, a small town in northern Italy. I have a degree in law but I interrupted my career as a lawyer. I now work as an employee in a transport company, dealing with legal matters. I have no other hobbies besides LEGO. When I'm not building I like to spend time with my wife.

T: I understand that you played with LEGO as a child but, like many of us, found other interests in your teens. What made you start building again?

A: I played with LEGO a lot—it

Girotto built this stylish model, called *Disneyland Dreams*, as a gift for his beloved wife. It houses a real music box for sound. Two rotating platforms show popular Disney characters and the famous Disneyland castle spinning in different directions, which was quite a challenge in LEGO. The Mickey Mouse figure at the bottom can be pulled out, revealing a secret drawer with a romantic gift inside.

Nutcracker. This is another elegant music box Girotto built for his wife. This one contains not only a real music box and dancing figures, but also tickets to the ballet, to thank her for putting up with his LEGO obsession.

was definitely my favorite toy! Then, like many others, I grew up and simply abandoned the bricks. I began building again when my niece and nephew were children. I used to buy them lots of LEGO sets and I played with them a lot, knowing LEGO was a good and creative toy (and maybe also because I wanted to play too!), but I never bought anything for myself until I got married and we went to live on our own. Architectural sets provided a nice excuse to buy some things to put on our new home's empty shelves, and also because my wife is an architect and she liked them, even if she didn't like LEGO.

From then on I started collecting. Soon I wanted to do something "personal," beyond the building sets you find in stores. I began searching the internet and I found a whole new world of adults who love LEGO. These were people who build phenomenal stuff, offered online shops for spare parts, and so on.

Kinetic creations like yours caught my attention more than others. Also, when I saw one from Korean builder Bangoo, which included a music-box mechanism, I decided to try making one of my own. That Christmas (2016) I made a simple mechanical music box. It was a sort of snow dome depicting my newborn godson and his parents, with a simple Christmas tree turning around.

They loved it. I loved it too, because it was personal and I enjoyed thinking about it, finding solutions, trying gears, etc. It was something new for me. Despite all the mess in my room and the frustration while trying different things, the satisfaction when "it all runs" made me think, "I want to make some more!"

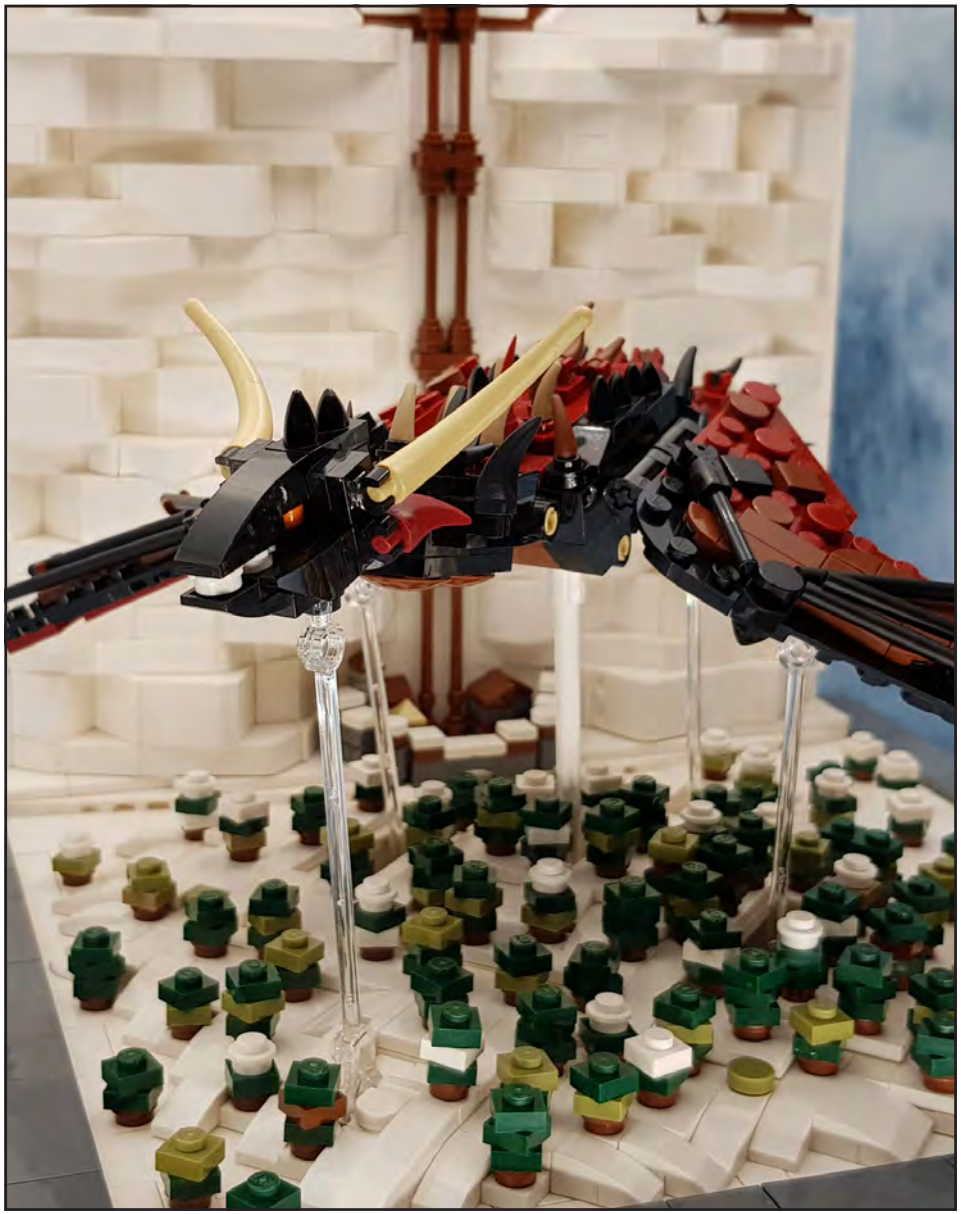
That's how my passion for LEGO automata started. Since then, I searched for inspiration, techniques, and notions in order to understand mechanisms and to try to make better movements.

T: I'm delighted that you cite me as an influence. Were there other builders who inspired you to start designing your own models and/or helped you along the way?

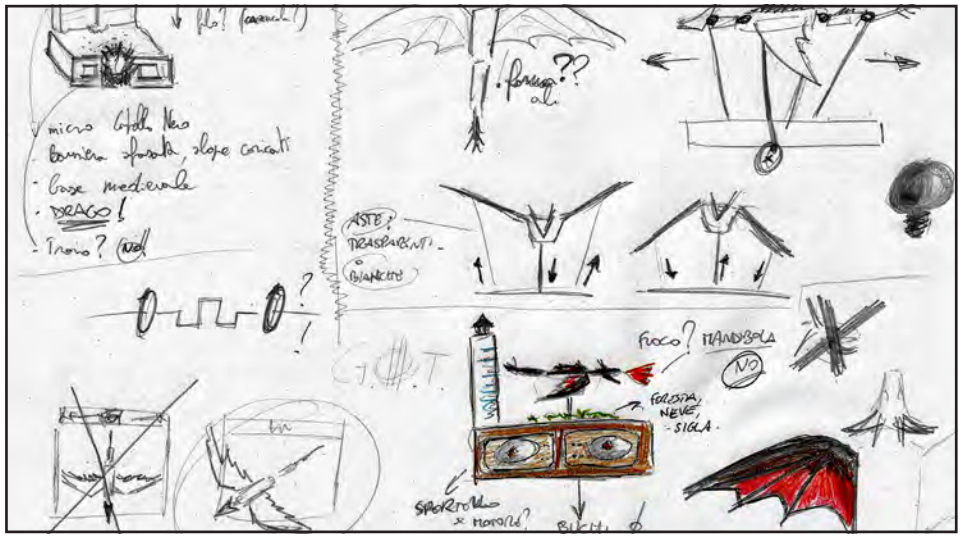
A: Well, I must say JK Brickworks [see *Automata Magazine*, vol. 2, no. 5] was really helpful, since they share a lot of instructions. Plus, Jason Alleman is a very kind person who answers questions and gives advice!

Yoshihito Isogawa's *Technic Ideas* books were a great source

Santa is Coming. Nothing says "jolly" more than Santa of course. This musical automaton (once again with built-in music box) depicts a very cozy and richly detailed house on a snowy Christmas night. Inside, wrapped presents and a toy train running around a Christmas tree await the residents, while Santa makes his getaway.



Game of Thrones: The Wall. There are quite a few kinetic LEGO dragons flying around the internet, all using more or less the same mechanism, but Girotto succeeded in tuning it to perfection for this model. The elegant motion of his ominous, beautifully crafted dragon is a sight to behold, as are its lavish surroundings.



Game of Thrones sketch. Girotto says he hardly uses any drawings or computers while building his models, preferring the hands-on/bricks-on approach. But occasionally he will make small sketches for later reference. This early sketch for his *Game of Thrones* automaton gives us a peek into his creative process.

of mechanical knowledge applied to LEGO. Besides other LEGO builders, I also try to get inspiration from non-LEGO automata makers.

T: How do you work? Do you always use sketches? Do you work things out on a PC before you get into bricks?

A: I always start with a "main movement" I would like to express, combined with a subject. I work on this first to get an idea of the feasibility. Then I begin figuring out other movements to implement. The scene grows around the mechanism. The music must sound suitable for the scene (in my mind, at least).

Sometimes I make sketches, especially if I am not home and cannot put my hands on bricks. Generally, these are messy and confusing. I'm messy too, which is why I often find my sketches destroyed in my pockets! That's a shame, because I love to look at them after I finish a work. I love to see how the idea came to life, changing shape along the way.

It's really important to me that the main movement and the emotion I want to transmit stay consistent from beginning to end. It is a form of

Quidditch. Harry and Draco battle it out in the skies, swaying from side to side in a race to grab the elusive flying snitch. The scale of the figures is an unusual and challenging one in LEGO because fewer details are possible. The characters are still easily recognizable, though, and dynamic in appearance. The tiny spectator boxes below create the nice illusion that the two players are miles up in the air.

Quidditch mechanism. As with his *Game of Thrones* automaton, Girotto chose to make the main line of action and its mechanism diagonal across the box. This was a bold choice. Not only can this be quite difficult to achieve in LEGO, but it also makes these models much more dynamic and adds to the effectiveness of their forced perspective.

communication and a way of expressing myself.

I am not very comfortable working on the PC because I need to make tons of changes with my hands, testing movements and stability. If I had to rebuild every time on the PC as well, it would be too stressful (not to mention that my desk is overflowing with bricks when I build, leaving no space for a keyboard).

T: What makes LEGO your preferred medium? What do you consider the main advantages and/or disadvantages of working with LEGO as opposed to other materials?

A: First of all, I have a strong emotional bond with LEGO, as it brings me straight back to my carefree childhood. The sound of rummaging in a LEGO box just makes me feel good, relaxed, and "switched off" from everyday life and matters.

Besides personal feelings, the main advantage of using LEGO is provided by its own nature: an interlocking building-block system. That means you don't need to cut, glue, carve, attach, pierce, weld, or paint anything. Consequently, you don't need a real workshop, because you

Back to Hogwarts. This style of miniature building, or "microbuilding," has quite a large following within the LEGO community. It requires a lot of patience and skill to invoke the right look using very few pieces. Creating movement is even harder, so kinetic models using this scale are quite rare. Fortunately, Girotto enjoys a challenge. Not only is his tiny Hogwarts instantly identifiable, but the model clearly features Ron and Harry's Ford Anglia flying toward the castle; even the Hogwarts Express is running at the bottom.

Hocus Pocus. Having corresponded with Keith Newstead, Girotto based this automaton on one of Keith's automata as a thank you. He changed the decor to suit his own fancy and added his trademark music box to the build. A laughing witch stirs her strange brew in a cauldron on a beautifully sculpted hilltop, while her cat keeps watch. It must have been quite a LEGO-challenge to make the figure follow the movement of the stick so fluently, but Girotto executed this very well. The scene is packed with wonderful details like rats, mushrooms, bones, and even a dangling spider that moves up and down. Also, please note the brilliant use of a frog piece for the witch's nose!

won't make any dirt, any smell, or (almost) any noise.

The disadvantages are, again, inherent in its nature: joints, gears, and dimensions are limited. That means you can't always make whatever you want, especially if you want to contain it in small spaces. Colors and availability of pieces are limited too, which means that sometimes you have to change a plan just because the piece you need doesn't exist in a particular color. Weight is another enemy. The more complex the model is, the heavier it will be, and plastic gears really don't like that. Oh, and it's not at all cheap!

But the disadvantages for me are part of the challenge, like a game, with its own rules to follow: creating that particular movement, using only LEGO and no glue or paint. After all, LEGO pieces are made to be eventually disassembled and reused to make something else. A LEGO model is potentially ephemeral. I find that poetic and stimulating.

T: You have a love for music boxes, and I believe there is a romantic story behind some of them, is that right?

A: As I said, the first one was for my godson, since his mother loves snowdomes and music boxes. Then I couldn't help building some for my wife too. Despite the fact that she doesn't love LEGO, she is my main supporter, and she helps me a lot, even in the creation process. So, I built the *Nutcracker* and *Disneyland Dreams* for her and her passions.

Each one hid tickets for the ballet or for a trip to Disneyland. She's a real angel, tolerating me and my strange hobby (a monopolized room, LEGO everywhere, strange screams if gears don't run…), so she deserves something special. Also, she tolerates me more if I say I will make something for her!

T: Your versatility is very impressive. Do you challenge yourself to make every model different from the last, or is this something that naturally happens?

A: Sure, I challenge myself with different models every time. It is more stimulating. Even if I am satisfied with a particular movement, I prefer to try something new, rather than replicating the old one.

Treasure Chest. A unique and very clever model. The chest opens up to reveal its hidden treasure: a tiny pirate ship rocking on the Caribbean waves, with a small tropical island in the sunny background. Once again, a built-in music box provides the scene with dreamy ambiance.

T: I understand you were in contact with the late, great Keith Newstead. Would you tell us something about that?

Oh, "in contact" is maybe too much. I bothered him a couple of times and he was kind enough to answer me. He advised me on recommended reading for newbie automata lovers: *Cabaret Mechanical Movement* by Gary Alexander and Aidan Lawrence Onn and *Figures in the Fourth Dimension* by Ellen Rixford. I also showed him some of my latest stuff, and he appreciated my dragon's movement. My last work, *Hocus Pocus* was meant to be a tribute to his *Witch* automaton in my own way, just to thank him for the great inspiration. Unfortunately, he passed away before I could show him and ask his opinion. He was a great artist and will always be an inspiration to all of us.

T: Is there anything cool you're working on at the moment?

A: Yes, I am working on something really nice. It's too early to say, but I am trying to raise the level of complexity without giving up on poetry. I hope we will chat about it when it's finished. Ciao! A1.

Web Links

Jolly 3ricks on social media
https://www.facebook.com/jolly3ricks
https://www.instagram.com/jolly_3ricks/

Back to Hogwarts parts list and instructions available at
https://rebrickable.com/users/Jolly3ricks/mocs/

Yoshihito Isogawa *LEGO Technic* books
https://www.amazon.com/Yoshihito-Isogawa/e/B0042LH2H2%3Fref=dbs_a_mng_rwt_scns_share

Cabaret Mechanical Movement by Gary Alexander and Aidan Lawrence Onn
https://tinyurl.com/ec6nrurk

Figures in the Fourth Dimension by Ellen Rixford
http://www.figuresinthe-fourthdimension.com/

Video Links

Jolly 3ricks Youtube Channel
https://www.youtube.com/channel/UCsru2_nU5zNMPx-P9qZPYaSA/videos

Keith Newstead's *Witch* automaton
https://www.youtube.com/watch?v=f1dfk4XDURw

Get Moving

The Bizarre Belle of the Ball

by Kim Booth • Berlin, Germany • Photos by the author

Some while ago I enjoyed watching a video proaduced by an Italian artist Giuseppe Ragazzini (*https://www.youtube.com/watch?v=VurUCgxdp8E*), and I thought it would be fun to make my own real world, wooden version of a device similar to what he showed in his video, but that didn't need an internet connection. Then a friend gave me some doll's eyes—the sort that close when the doll is put to sleep. That was enough to finally get me started on *The Bizarre Belle of the Ball*.

Requirements

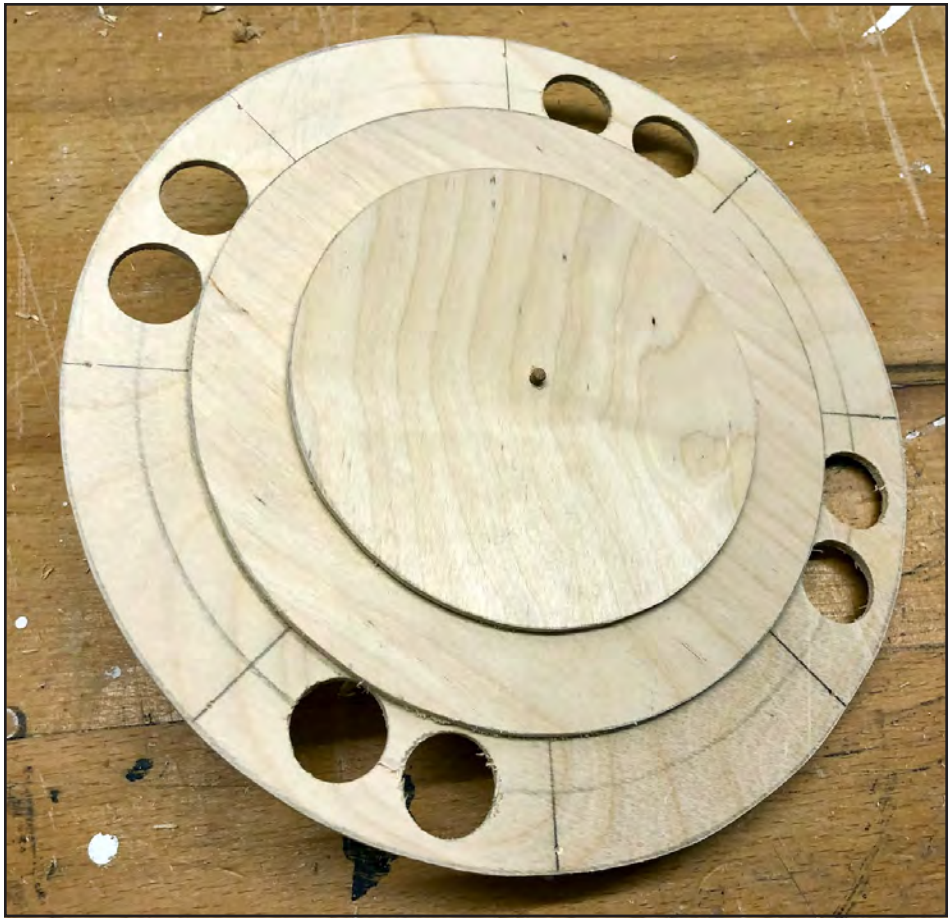
I chose to have eight sets of eyes mounted on one disc, eight noses on a second disc, and eight mouths on a third disc. These provided enough variety for 512 distinct faces, so the belle can go to 512 balls and never have to look the same twice. The three discs can be seen in **photo 1**.

To frame each face and concentrate the viewer's attention on it, it seemed best to use the belle's arms. Whenever her eyes are correctly aligned, both arms would be raised. To make it a more convincing gesture, she should be holding a mirror in one hand to admire the finished effect, and a comb in the other to tidy her non-existent hair. One turn of each control knob would rotate one of the discs through exactly one eighth of a turn.

Making

The smallest 3mm-thick (⅛") plywood disc (mouths) is attached to a solid 6mm (¼") axle. This axle runs inside a thicker, hollow axle for the middle-sized disc (noses). The largest-diameter disc (eyes) revolves around both. Several spacers join this disc to its gear to

This belle of the ball can changer her appearance 512 times and never repeat.



1. Three discs on which to mount the eyes, noses, and mouths. The discs revolve independently on telescoping axles.

2. The "eyes" disc connected to its large gear with spacers.

3. The three large gears were stacked and cut simultaneously on the scrollsaw.

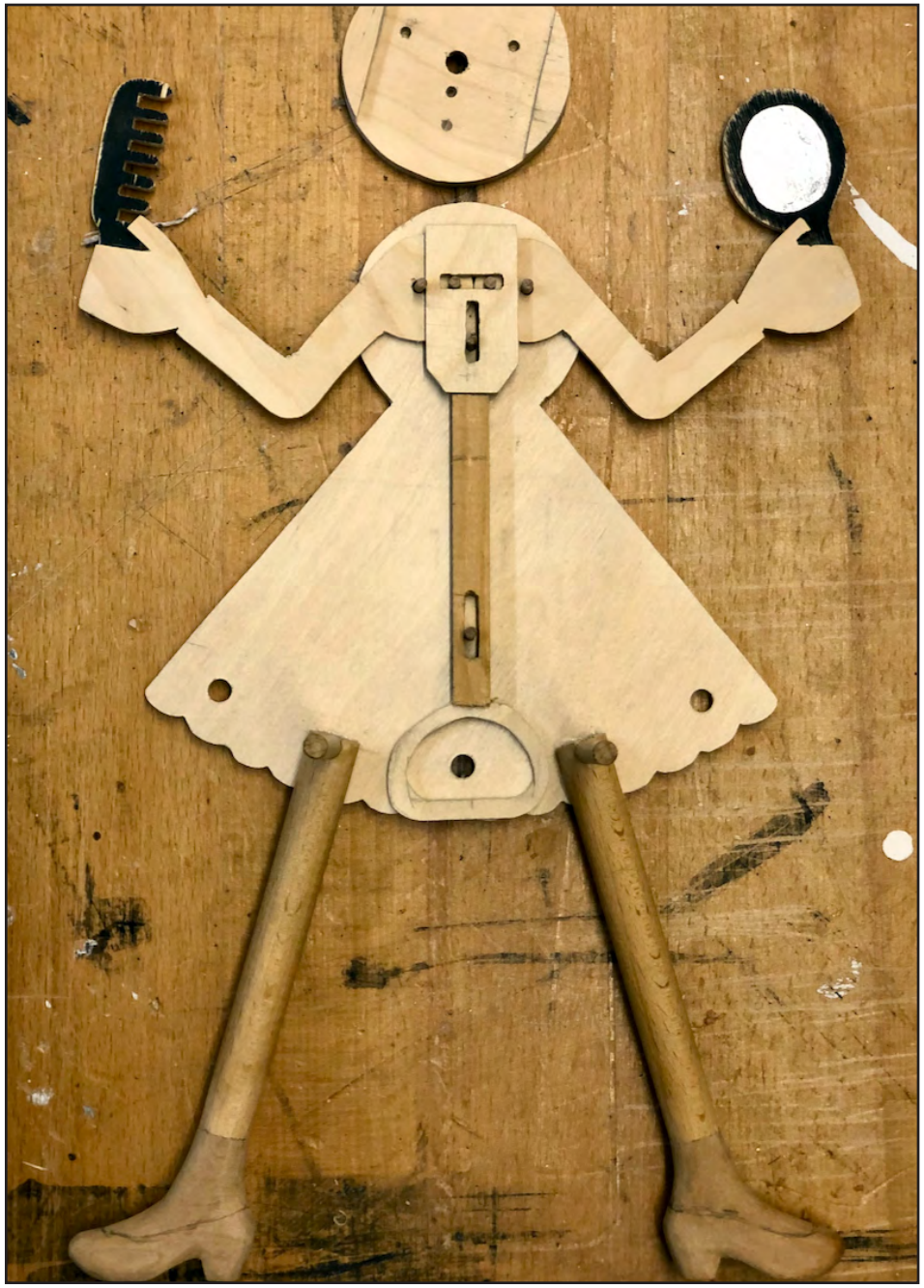
4. Body front (left) and back (right), and four legs.

leave room for the doll's eyes (**photo 2**).

If that sounds complicated, **figure 1** shows a section through the middle. This means you are looking at these discs from the side.

To make the three discs turn, three large gears behind them were required. Small gears drive the big ones, so the number of teeth was important to set the speed of rotation of each disc. With eight noses, etc., the number of teeth on the big gears had to be eight times the number of teeth on the small ones, so that one turn of the control knob by the user moved the disc precisely from one nose to the next. I chose seven teeth for the small gears, which then meant 56 teeth for the big gears. I have found that gears with small numbers of teeth can jam easily, and seven is quite close to the limit.

To shape the gears I used Matthias' splendid online gear template generator (*https://woodgears.ca/gear_cutting/template.html*). To save time and work here, I first pinned three sheets of 6mm plywood together, glued the template on top, then cut the three large gears at once with my scrollsaw (**photo 3**).



5. The inside of the front part of the body, with the lifting mechanism for the arms. Mirror and hairbrush help to focus the viewer's attention on the face.

6, 7. Six small gears to drive the large gears are mounted to the rear part of the body. Note the different spacing of each pair of gears from the rear wall.

Video Link

It is easiest to understand the mechanism when you can see it in action, so click here to watch our belle of the ball deciding how to look for her next ball: https://www.youtube.com/watch?v=gMLE70_scGE

Body and legs

To hold the rotating discs and gears, some sort of frame was required. A dress with a wavy frill at the bottom and a round upper body seemed about right (**photo 4**). Two legs would be a bit unstable, so my bizarre belle has four. The front part also had to carry the mechanism to raise the arms (**photo 5**). Some elegant carved shoes were, of course, needed to equip our belle for the ball.

The holes between the legs support an axle fitted with an eccentric cam. As this axle is turned, the cam presses the vertical actuator down, which pulls the arms up. The loose, round part at the top is a cover to keep all of the parts in place. The hole in the middle also serves as the bearing for the axle of the rotating assembly.

8. Unpainted, the automaton is partially assembled.

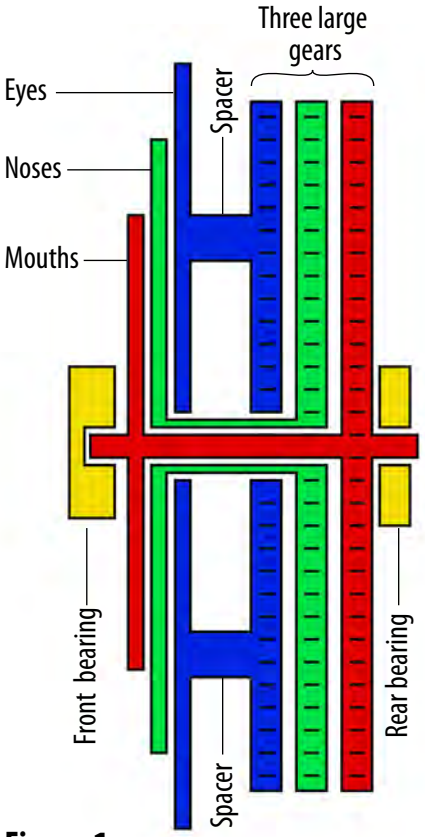


Figure 1
Section through the middle
(not to scale)

The rear part of the body carries six small gears, two for each large one (**photos 6** and **7**). Each pair is set at the correct height to drive its own large gear, and hence the corresponding disc with noses (left), eyes (center), and mouths (right). Each knob on the front of the figure turns an axle that turns one of the small gears. The reason for the second, identical gear is to provide enough space for the hats on the largest disc to move unimpeded. Because the two small gears are identical, there is no change to the transmission ratio, and one turn of the knob will still move its disc through one eighth of a turn.

When putting the parts together after carving eight noses, our bizarre belle started to take shape (**photo 8**). I was surprised to see that, when near horizontal, the doll's eyes close and open one at a time, as if they are winking at me. Since I only had four sets of doll's eyes, I improvised eyes for the other four faces.

Lessons learned

I had originally planned to use three cranks in front of the dress to turn the parts, which would have meant putting the figure on a heavy base. I find that, when turning a crank, models tend to skitter around on the up stroke unless they are heavy enough or have a non-slip coating underneath. By changing to spherical knobs, which must be twisted to operate, the upward force disappears, and with it the need for a base. Magic!

AUTOMATA FOR BEGINNERS

Scaling up

by Sarah Reast • Llanbrynmair, Wales, UK • Photos by the author

If you have an automaton that you love, it can be very tempting to say, "Let's make a really big one!" If something is fun and captivating on the table top, think how that fun could be amplified if it was four times as big!

A large and chunky mechanical model, if sufficiently robust, is a great thing to have at an event or an exhibition, especially if you want to get children engaged, so it's good to know some of the dos and don'ts. I have often made bigger versions of things to use in workshops with children. This makes it possible for them to get their hands on and really feel the weight, the friction, and the forces necessary to make things move, which are sometimes less tangible in a small model.

The problem is that physics gets in the way. Simply put, if you build something twice as big, it won't necessarily have twice the strength required to function properly with the additional weight.

I'll start with an example of scaling up that had a positive advantage.

1. The original Timberkits *Trebuchet*, in front and to the right, is 33cm long. The giant version is about three times the size.

The Timberkits *Trebuchet* operates on the principle of a force generated by dropping a heavy weight, thereby slinging a projectile over a long distance. Clearly, the more weight you can build into the system, the better it will work. We built a meter-long (39") *Trebuchet* as a scaled up version of our standard 33cm-long (13") kit and we had a great time testing its capabilities. In this design, there are not too many parts of the mechanism that rub against each other to create friction and the overall simplicity is its strength. This model provides a lesson in math, physics, and history, all in one (**photo 1**).

The *Guitarist* is an example of a scale up that had neither a net gain nor loss. An enterprising customer decided to make a really big version, with hair and a full-size ukulele, and hook it up to a hefty motor (**photo 2**).

The potentially limiting factor with this mechanism can be seen in the components colored red in **figure 1**. The round cam below pushes the lever that is an extension of the *Guitarist's* leg above. The weight of both his upper body and the guitar rests on this leg, so the cam has to contend with that. This puts a strain on its fixing to the drive shaft and the power input (hand cranked or motor driven). However, once again, the simplicity of the whole thing was its salvation and it worked a treat.

2. The original Timberkits *Guitarist* can be seen on the platform at the right. It's 26cm (10") tall, while the giant version's height is about one and a half meters.

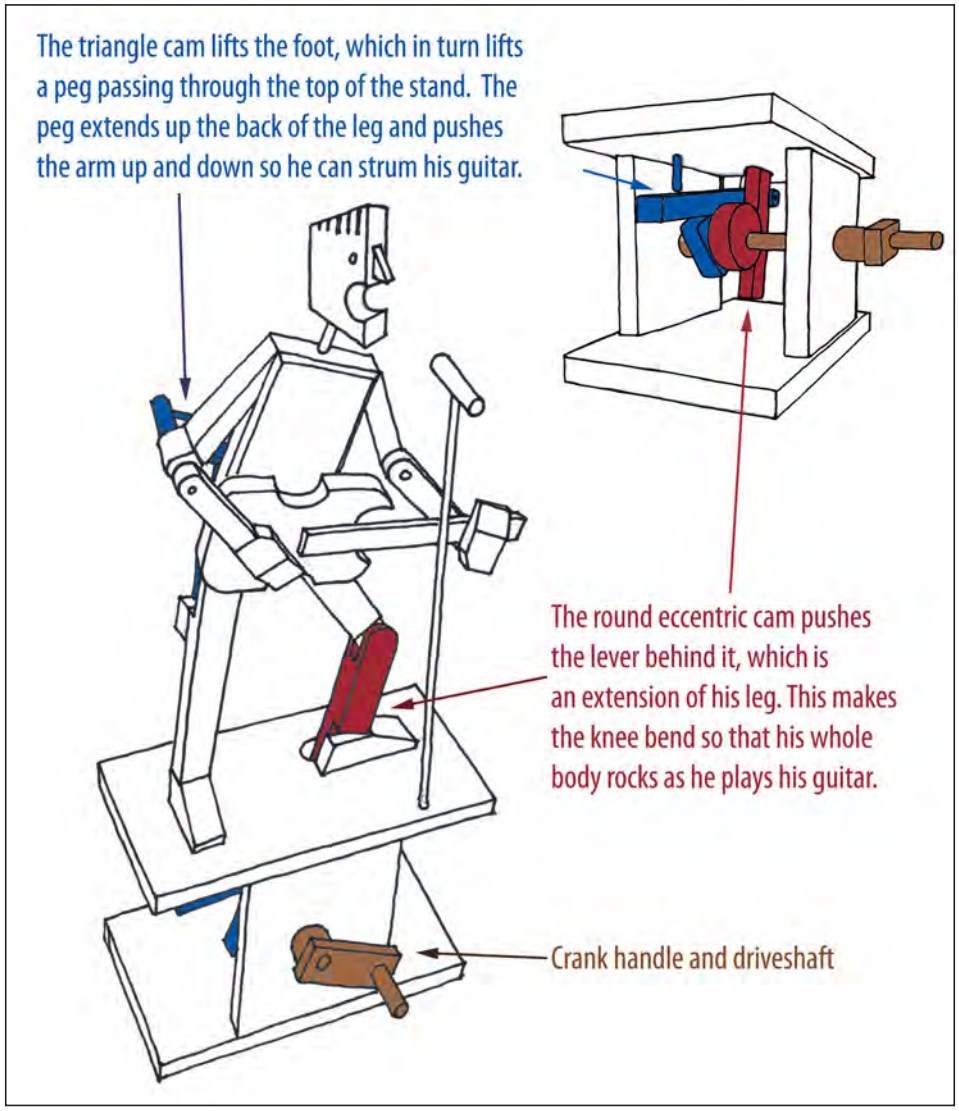
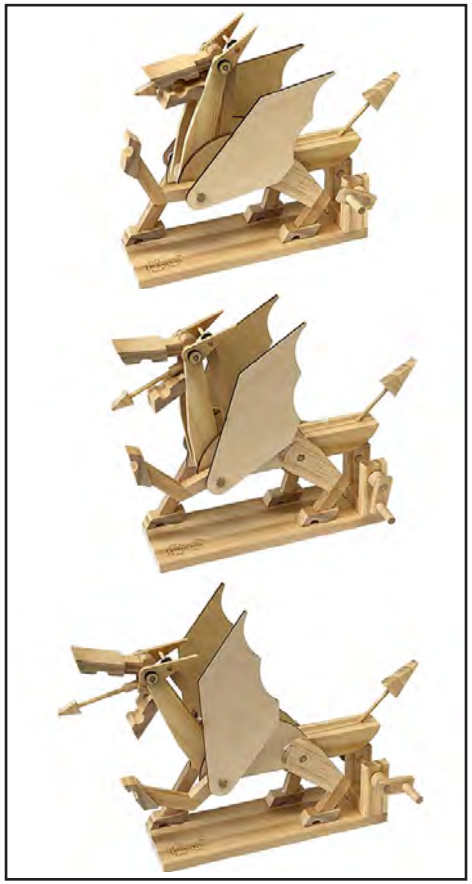


Fig. 1. The *Guitarist* mechanism.

The *Dragon* (**photo 3**) presented a much more considerable challenge. As you turn the handle, its neck extends forward and its jaw opens wide. This is achieved by linkages pivoted through the head and pushed and pulled by a cranked cam at the end of the drive shaft. We made a 1.2m-long (42") version, initially for a window display in Harrods, London. It was such a great mascot that it ended up making quite a few tours around the country to other venues. She was fondly called *Gwen* and enjoyed a road trip in the back of a soft-top Mini (**photo 4**).

The trouble with this project was the sheer weight and force of that neck lunging backward and forward, and the resultant strain on the pivot through the shoulders. This pivot was first made with ramin dowel, which soon split. This was replaced with beech, which also split. We then had to introduce a metal shaft, which presented the problem of fixing the wooden components to it—they all had to be drilled and pegged. This solved the problem initially but after years of shock, as the heavy rocking motion kept hammering the joints, the whole thing basically shook itself apart and poor old *Gwen* had to be retired.

Bounce and bind are other problems to look out for. We have made a lot of scaled-up Timberscenes, which are basically two-dimensional sheets of scenery with some moving layers riding on cams below (**photos 5** and **6**). These moving layers are only loosely guided so they can slide across the cams a bit. At a small scale, they are so light that the momentum of them bouncing along at a reasonable speed keeps them moving. The larger versions don't bounce so happily, and just bind. This illustrates a general principle: the larger you



3. The full reach of the *Dragon's* neck.

4. *Gwen* (in the back seat) on tour.

5. The original Timberkits *London Cityscape* model can be seen at the right, front. It's 26cm (10"), which makes the giant version three times bigger.

go, the more controlled, guided, and accurate each mechanism needs to be. You can get away with a little more slack with a small model.

There is something about making giant versions of anything that is just as captivating as making miniatures. I can't fathom why, but there must be something deep in our brains that delights in the playfulness of subverting a norm. Whatever it is, it's lots of fun and I encourage you to go for it. AM

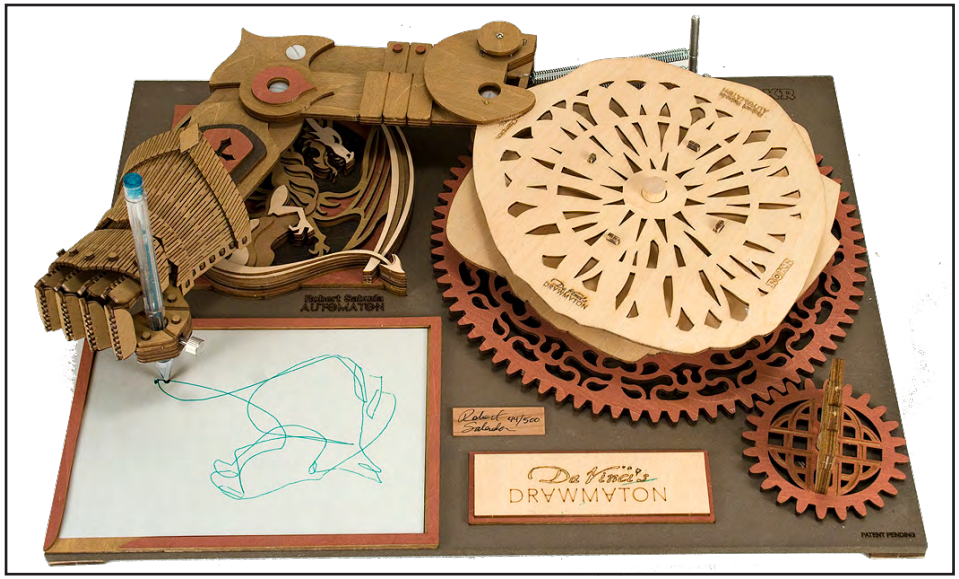
6. The *London Cityscape* sideways on, showing how the wave sections at the front ride on a series of cams. Ideally these need to be good and parallel. Otherwise they bind.

Contacting Sarah

If you have questions or comments for Sarah Reast, you can write to her in care of *Automata Magazine*: automatamag@comcast.net. Just put "Message for Sarah" in the subject line.

Sarah is the designer and director of Timberkits Ltd., which creates wooden mechanical models sold in kit form. To learn more about her company, visit https://www.timberkits.com/.

Da Vinci's Drawmaton
Laser-cut wooden drawing automaton
Finished size: 15¾" x 12" x 3½" (40cm x 30.5cm x 9cm, respectively)
Drawmaton website: *https://www.drawmaton.com*
Email: *hello@drawmaton.com*
Price: See text

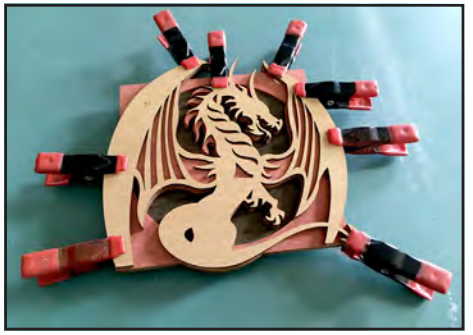


The finished *da Vinci's Drawmaton*.

The Drawmaton project was begun by the Leondardo da Vinci Robot Society (now defunct) in 2019, the 500th anniversary year of Leonardo da Vinci's death. The model is based on da Vinci's *Robot Knight*, an automaton that could move through a variety of actions. It was considered by many to be the first programmable robot. The machine reviewed here, called *Da Vinci's Drawmaton*, was designed by Robert Sabuda, probably best known for his astounding pop-up books.

The *Drawmaton* is offered in three versions, as follows: *Robot* ($99US), *Gambler* ($109US), and *Slayer* ($119US). They are all mechanically identical but vary in aesthetics and

Components of the kit.



Parts clamped while gluing.

detail, and each kit is produced in a limited edition of 500. In the US, these are available directly from Drawmaton. Those outside the US must go through a third party, such as *https://www.myus.com/* Our review sample is *Slayer*.

The kit arrived neatly packaged in a beautifully printed box. Inside I found around 19 laser-cut plywood sheets in three different colors; a pair of colored pens; two small tubes of white glue; a bag of miscellaneous parts and hardware, including two very small pieces of sandpaper; a pad of paper; a small piece of paraffin wax; and a full set of instructions. The instructions indicated that I'd also need a screwdriver (which, in fact, was included) and a small hammer. I would add to that list a handful of spring clamps or clothes pins. Also included is a small piece of wood actually signed by Robert Sabuda, telling what number in the edition your particular kit is.

The instructions are almost entirely graphical in nature, with a few text notes along the way. There are a total of 57 steps. It's important to read through the instructions and understand what the different symbols mean: waxing, gluing, "this side up," etc. Drawings for each step are precise and show you exactly what must be done. Every part is identified by number and referred to in the instructions. Most steps are easy to follow, but you must be very careful to fully understand what is intended before rushing on to the next step. On some steps it is easy to accidentally glue parts in backward or upside down.

Parts are held onto their plywood backer sheets by tiny wooden tabs. These are easy to break through to punch out the part, but some of the

parts are quite fragile and could be damaged when punching them out. Once a part has been liberated from its sheet there will be tiny burrs where the tabs were. These should be sanded smooth.

Assembly is straightforward. A baseboard is supplied that appears to be made of black MDF. In it are various holes and etched-in outlines. Wooden dowels form axles for the moving parts. Clear instructions and a guide are provided for positioning the axles at exactly 90°.

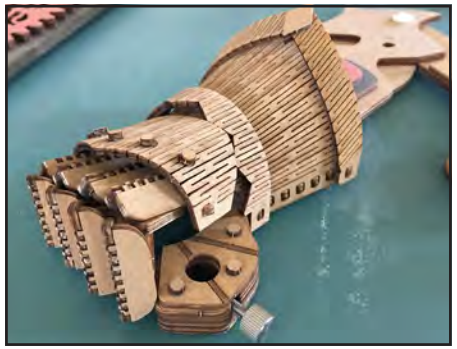
Two gears are supplied, one large and one small. I ran into an interesting problem here. I had taken great pains to ensure the axles were perpendicular to the base plate, so the gears should lie flat. However, they didn't. They should, though, as they were not warped. On close examination, I discovered that the holes in their middles were not perpendicular to the sides of the gears. The laser head must have been slightly cocked when they were cut. Fortunately, the fix was easy. I rolled up a piece of sandpaper, sandy side out, and ran it through the holes a few times until the gears did lie flat. Problem solved.

Many parts are keyed in place by laser-cut wooden pins. The pins are rectangular in section but their holes have rounded ends. I found that some of the pins slipped in easily but

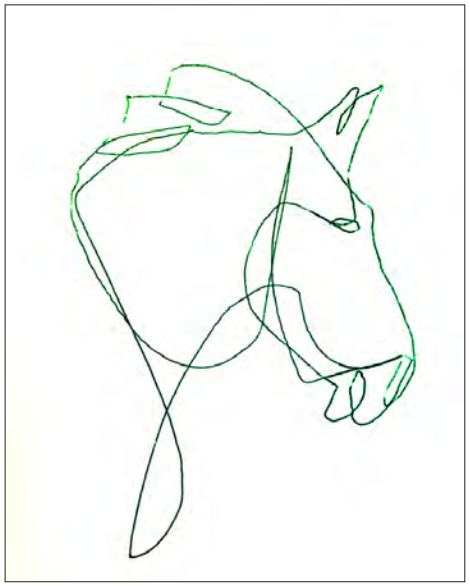
The finished dragon motif.

others did not. Knocking the corners off the pins with sandpaper made their insertion much easier.

Overall, the *Drawmaton* went together smoothly. It is well engineered and all of the parts fit as they were supposed to. This is, however, by no means a snap-together kit, and I suggest that you have some experience with simpler laser-cut kits before tackling this one. I spent several hours assembling the myriad detail parts involved. Much of this involved putting together the beautiful decorative dragon, which is built up in many layers of plywood. Some of the thinner plywood sheets had small warps in them. It was here that the spring clamps came in handy, holding laminated pieces flat and in place until the glue set.



The Knight's hand, which grasps the pen.



Horse, drawn by the *Drawmaton*.

Mechanically, the automaton is fairly simple. A small gear drives the larger gear, to which are mounted a pair of "petalos" or cams, one above the other. These control the "x" and "y" axes of the arm. Four sets of petalos are supplied with the kit, producing drawings of a horse, a skull, a tulip, and a girl. A set of four additional petalos are available ($39US) to produce a bow tie, an elephant, a dragon, and a swan. If you are very clever, you could make your own cams to draw anything you like.

The edges of the petalos must be sanded smooth and waxed so that they slide easily over the cam followers, which are brass pins. In operation, you turn the small gear, which more slowly turns the large gear and the cams. This causes the arm to move in the pattern of the drawing. One of the provided pens is clamped into the unit's hand and a piece of paper is placed in the drawing area. You are admonished in the instructions to turn the small gear *very* slowly. I found that the more slowly you turn the gear, the better the drawing turns out.

This is a remarkable piece of work. It is finely engineered and well produced. The final product, in addition to actually being able to draw the images, is a thing of beauty in itself and could almost be mounted on the wall. It's not only a reflection of da Vinci's genius, but a real example of Robert Sabuda's artwork as well. I had no qualms about affixing his signature to it. Highly recommended.

— *M. Horovitz*

The End